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CONTENTS.

Editorials 669
Programme of the Convention of the National Electric Light Association.. 671
Electricity Applied to Heavy Railway Service 671
Electricity at the Trans-Mississippi and International Exposition..... 672
The Trip of the Northwestern Electrical Association..... 672
Oscillatory Currents and Some of Their Phenomena—IV., by Prof. E. F. Northrup..... 674
Transformer Regulation, by A. R. Everest..... 676
The Shaft Governor, by Thomas Hall..... 678
A New Water Battery, by A. C. Longden..... 681
Letters to the Editor..... 682
A Short Method of Determining Transformer Efficiency, by Frederick Bedell..... 683
At the Exhibition..... 684
Digest of Current Electrical Literature, compiled by Carl Hering..... 689
A Battery Telephone Generator..... 693
Heavy Electric Railroading Proposed in France..... 693
Electric Gas Lighting Attachment for Incandescent Burners..... 694
Gravity Motor Controller..... 694
Jagabi Portable Testing Set..... 694
Departments:
Financial Intelligence..... 695
Special Correspondence..... 695
A Few of the Exhibits at the Omaha Exposition..... 697
General News..... 697
Legal Notes..... 698
Personal Note..... 699
Obituary Notes..... 699
Trade and Industrial Notes..... 699
Business Notices..... 699
Illustrated Record of Electrical Patents..... 700

THE LIGHTING OF LARGE INTERIORS.

In the early days of electric lighting the open arc lamp afforded the only method of illuminating large apartments more satisfactory than gas, but the disadvantages of the naked arc, namely, the unsteadiness of its light, the concentration of the source and consequent sharp shadows and disagreeable effects on the eye caused the substitution for this system of large banks of incandescent lamps, in spite of their greater current consumption for a given quantity of light. The perfection of the modern enclosed arc lamp, however, changes the conditions materially.

One of the most striking instances of the relative advantage of enclosed arcs over the incandescent lamp for this purpose is shown in the illumination of Madison Square Garden for the Electrical Exhibition, described in the exhibition notes in another column. One great "arcolier" in the centre of the garden, with thirty-seven 5-ampere arc lamps, gives an illumination which makes the 2200 incandescent lamps previously used look very weak and red. It is estimated that this "arcolier," with two smaller ones carrying sixteen arcs each and one arc in place of each of the twenty-eight rosettes of 12 incandescent lamps each now in use, would give a far more brilliant illumination than the present system. This would require some 500 amperes at 110 volts in place of the 1200 amperes now used.

While it is an unsafe thing to attempt to base exact comparisons on the relative aggregate candle power of different systems of lighting, a rough comparative idea can be obtained in this manner: Twenty-two hundred 16-cp incandescent lamps aggregate 35,000 candle power when new and perhaps 30,000 candle power average, with a current consumption of about 1200 amperes, while 100 arc lamps of the type now in use, with 5 amperes and 80 volts at the arc, would consume about 500 amperes and—rating them at the value of 400 mean spherical candle power each—would give 40,000 aggregate candle power. The light of the arc lamp is far whiter and a better imitation of daylight than the more reddish hue of the incandescent, while the disagreeable bluish features of the open arc are subdued by the opalescent shades of the enclosing globes. Of course, in small apartments, the increased diffusion of a few incandescents over one arc lamp is an advantage, but where the comparison is between scores of arc lamps against hundreds or thousands of incandescents, the source of light is so well distributed in either case that there is no advantage on this score. The fact remains that the expenditure per candle power of an arc lamp is about 1 watt or at the most 1½ watts per candle power, while that of an incandescent averages nearly 4 watts per candle power.

The ideal method of illumination is one in which the visible source of illumination shall be a large surface, preferably the whole ceiling of the apartment. This can either be illuminated from above or below. In the former case, to obtain proper diffusion, some 30 to 50 per cent. of the light is necessarily lost in transmission through the diffusing medium, while in the other case rough tests made with the artificial moon at Columbia University* showed that perfect diffusion by reflection can be obtained with a loss of but 20 per cent. With diffusion obtained by either of these methods, pref-

*See THE ELECTRICAL WORLD of March 12, 1898.

erably the latter, the light obtained from arc lamps is far more perfectly distributed than even that of an equivalent number of incandescents, and in spite of the losses the consumption of current remains markedly less.

THE RECENT PATENT DECISIONS.

Two more steps have been recorded in the history of the series of suits brought by the General Electric Company against the Walker Company, for the infringement of the various electric railway patents owned by the former company. One of these is the opinion of Judge Townsend in the United States Circuit Court, in the suit of the Electric Car Company of America and the Thomson-Houston Electric Company v. the Hartford & West Hartford Railroad Company. This is for an infringement of patent No. 393,323, issued to George H. Condict in 1888, virtually covering the combination of rheostatic and series multiple control for electric motors, particularly for railway purposes.

A brief review of the state of the art and Mr. Condict's patent will make the present status more clear. Previous to the time of Mr. Condict's invention rheostatic control was, of course, well known, and the series multiple control with commuted or variously grouped field coils, but without the use of so-called dead resistances, had been patented by Mr. Rudolph M. Hunter and others. Great difficulty was found in the arcing and burning of the controller contacts whenever the circuits were opened to change over to a new combination. Mr. Condict conceived and patented the idea of inserting step by step auxiliary dead resistances, in order to reduce the current between a running notch and the open circuit position wherein the connections were changed over for the next succeeding combination of armatures, field magnets, etc., various groupings of these different parts being described in Mr. Condict's specifications. This use of auxiliary resistances solely to reduce sparking has, of course, been entirely abandoned, magnetic blow-outs being universally used at the present time to accomplish the same purpose, but auxiliary resistances are now used in combination with series-multiple control for the same purpose that they were used previous to the invention of the latter, namely, to cut down the rush of current to the motors, the resistance being inserted between the change-over positions of the controller and the regular running notches, instead of vice versa. Unfortunately for the Walker Company, Mr. Condict mentioned and claimed this incidental use of resistances.

If the patent is sustained on appeal it will apparently seriously handicap the Walker Company in the street-railway field, unless some means can be devised by the engineers of the company to get around the claims. One possible means of doing this is the placing of all the resistance windings on the motor fields if sufficient radiation or ventilation can be obtained, the Condict patent contemplating the use of auxiliary so-called dead resistances only. This is an arrangement early used by Sprague, but abandoned because of the difficulty, then insuperable, of keeping the fields cool. It has lately been revived again for motors used in other work and capable of better ventilation. The disposal of heat from railway motor fields can be improved in several ways, one obvious method being the ribbing or grooving of the frame, as iron-clad rheostats are corrugated to increase the area exposed to air convection.

It is questionable, however, whether the opinion will be sustained on appeal. The inventor described and claimed series multiple combinations of the windings of either one or both motors, a feature which is not used now by the Walker Company, its controller throwing the motors bodily from the series of the multiple combination. A defence may also be set up on the score of lack of invention, as rheostatic control had previously been used, both for motors in series and motors in multiple, which is all that is done in the control systems of the present day. The same patent covers the interlocking feature of reversing and main controlling switches, but as the claim on this was for a detailed construction, the Walker Company's use of the device was not considered infringing.

The whole question is one involving the nicest distinctions between details of considerable complexity and requiring an expert knowledge of the action of street-railway motors, windings and controllers for its comprehension. The opinion is a striking example of a technical discussion by one quite unversed in the art. No unfavorable criticism of Judge Townsend is intended by this, as no one man can be an expert in the various highly differentiated departments of modern industry. The result of the existing judiciary organization is that in a trial of this kind a large part of the time is spent in attempting, so to speak, to teach the court the science involved from the elementary principles up. As the opposing attorneys attempt to teach different versions, it is no wonder that, as in the present case, the final opinion indicates a rather confused insight into the subject.

The other matter of record is the decision of the United States Circuit Court of Appeals in the case of the Sprague Electric Railway & Motor Company against the Union Railway Company and the Walker Company, the real complainant being the General Electric Company. This is the appeal from the decision noted in The Electrical World of February 5, 1898, and upholds the two claims for a motor rigidly suspended upon the axle at one end and spring supported at the other, while reversing the opinion of the Circuit Court judge, considering uninfringed the third claim, covering a motor spring supported from the truck at both ends. It will be remembered that when Judge Wheeler's opinion was handed down, the Walker Company abandoned its motor suspension, comprising a spring support at both ends, and Professor Short devised a new type which should not infringe the so-called "wheelbarrow" suspension covered by the Sprague patent. In this the motor is rigidly supported by a sleeve on the axle and spring supported at the other end, and Prof. Short's design reversed the relation of the parts and rigidly supported the far end of the motor from the truck and spring supported the nose of the motor projecting over the wheel axle, this construction requiring—as did the all-spring suspension—a floating link to maintain the axle and armature shaft at the right distance for the proper meshing of the gears. Such a construction is obviously superior to the Sprague suspension in this respect, that the far bearing really is a spring support, in case, as is customary, the truck is supported on journal box springs.

The defense of the Walker Company was that its motor not being as a whole rigidly hinged to the axle, but merely connected to it by links loose at either end designed solely for maintaining the gears in mesh, it could not be read under the Sprague claim which specified "said motor being sleeved upon an axle of the vehicle at one end." The Court of Appeals held, however, that Sprague's invention did not consist in the details by which he attached his motor to the axle, but was more than a matter of construction and that a jointed or flexible extension was not only within the invention but within the claim. Claim 9 was not considered infringed by the Walker Company because it describes both spring supports from the truck or body of the vehicle, while the Walker construction utilizes a spring support directly from a sleeve on the wheel axle.

Programme of the Convention of the National Electric Light Association.

TUESDAY, JUNE 7, 1898.

Meeting of the executive committee at 9 A. M., secretary's office, Auditorium Hotel.

MORNING SESSION, 10.30 O'CLOCK.
CONVENTION HALL, AUDITORIUM HOTEL.

Address—President Insull.

Paper—Calvin W. Rice, Brooklyn, New York, "Cost of the Generation and Distribution of a Unit of Electricity."

Topic—"Prices and Discounts for Electric Current and Methods of Billing Current to Customers."

AFTERNOON SESSION, 2 O'CLOCK.

Paper—Alex. Dow, Detroit, Mich., "Public Lighting with Relation to Public Ownership or Control."

Topic—"Legislative Policy as to Public Service Corporations."

WEDNESDAY, JUNE 8, 1898.

MORNING SESSION, 10 O'CLOCK.

Paper—Herbert A. Wagner, St. Louis, Mo., "General Distribution from Central Stations by Alternating Currents."

Paper—Louis A. Ferguson, Chicago, Ill., "General Distribution from Central Stations by Direct Currents."

Topic—"Standardizing Apparatus for Central Station Use."

AFTERNOON SESSION, 2.30 O'CLOCK.

Paper—W. McLea Walbank, Montreal, Canada, "Cost of Producing Electric Power by Water Power from Lachine Rapids, Canada."

Report—Committee on standard candle power of incandescent lamps, Dr. Louis Bell, chairman.

Questions and Answers. What Is It You Wish to Know?

EXECUTIVE SESSION.

EVENING SESSION, 8 O'CLOCK.
AUDITORIUM HALL.

Lecture—Joseph Wetzler, New York, "Electricity Direct from Coal" (illustrated with stereopticon).

THURSDAY, JUNE 9, 1898.

MORNING SESSION, 10 O'CLOCK.

Paper—Prof. Winder Elwell Goldsborough, Purdue University, Lafayette, Ind., "Transformer Economy."

Report—Committee on amendments to freight classification, James I. Ayer, chairman.

Report—Committee on legislation concerning theft of current, James I. Ayer, chairman.

AFTERNOON SESSION, 2 30 O'CLOCK

Topic—"Freight Rates on Electrical Apparatus."

Report—Committee on finance, John A. Seely, chairman.

EXECUTIVE SESSION.

ELECTION OF OFFICERS.

As has been announced heretofore the various passenger associations have granted a rate of a fare and one-third, on the certificate plan, for delegates attending the Chicago convention. Arrangements have been made to have the New York delegation leave the Grand Central Station Sunday, June 5, via the New York Central, Hudson River and Michigan Central Railroad on a special train, leaving at 1 P. M. This train will stop at Poughkeepsie at 2:43; Albany, 4:30; Schenectady, 5:05; Utica, 7:03; Syracuse, 8:35; Rochester, 10:47; Buffalo, 11:50 P. M., Central time; Detroit, 8 A. M., and arrive in Chicago at 3 P. M. Monday. The train leaving Boston at 10:30 A. M. Sunday, June 5, will connect with this train at Albany. This being a limited train an excess fare of $1 is charged, therefore the railroad fare is $21 and the berth rate $5, making a total of $26. In purchasing tickets, delegates should be particular to obtain a certificate from the agent from whom the purchase is made, as in the absence of such certificate no rebate can be allowed on the return fare. In case the number of delegates attending should warrant, a special train will be run as a second section of the train named. Tickets can be procured at any ticket office of the New York Central Railroad and space reserved by applying to M. C. Roach, General Eastern Passenger Agent New York Central & Hudson River Railroad, 413 Broadway, New York.

Electricity Applied to Heavy Railway Service.

At a meeting of the New York Electrical Society on May 26 Prof. S. H. Short read a paper on this subject, which, while popular and elementary in character, contained some facts and conclusions of interest. After taking up the history of the development of the electric railway from the time of Davenport's first motor in 1835 to the present day, and prophesying that "we may expect to see eventually the conduit system more generally used than the trolley," the author takes up the subject of suburban and interurban lines.

The first suburban roads were merely extensions of existing city street railway lines following the settled lines of travel and reaching outlying villages at no great distances. Stops were frequent and speeds never exceeded 25 miles per hour. Their success, however, encouraged the building of regular suburban electric railroads, connecting towns and villages with the centres of population. These roads were equipped with light passenger coaches and motors suitable for speeds of from 40 to 50 miles an hour. One of the first of these was the road between Detroit and Mt. Clemens, Mich. This is 20 miles long, built along the side of the public highway, the construction being similar to that of steam railways. Stops are made only at definite points, and the trains run on a printed schedule. A running speed of 50 miles an hour has been made on this road.

Probably the most extensive suburban trolley service in the world centres at Cleveland, Ohio. The first line built there was the Cleveland & Berea road, 10 miles in length and occupying the side of the public road. The second was the Akron, Bedford & Cleveland, 35 miles in length and built partly on private right of way. Another is the Cleveland & Elyria, originally 26 miles long, but extended to Oberlin since, giving a total length of 40 miles. The Cleveland, Painesville & Easton has a length of about 25 miles, and is now securing the right of way to Ashtabula, 25 miles farther. The Cleveland & Chagrin Falls is 15 miles long, but is soon to be extended to Burton, 14 miles farther. The Lorain & Cleveland is 26 miles in length, and is heading for Sandusky.

Suburban roads are now securing entire private rights of way to avoid the delays and interferences incident on the traffic on the public highway. Light freight services are being added, the speeds are being increased, and roadbed, rolling stock and motors are made much heavier. Wherever suburban roads are paralleling steam roads, the electric road invariably gets most of the suburban passenger traffic, in spite of the higher speed of the steam road, furnishing the best proof that convenience of access, freedom from cinders and smoke and frequency of service outweigh the considerable differences in time of transit. The steam railroads have at last awakened to the fact that if they desire to continue their suburban service they must adopt electrical equipments. The Chicago & Northern Pacific Railway, which was practically a suburban steam road, has abandoned the struggle and leased its lines to the Suburban Railway Company of Chicago, which has equipped the entire system with high-speed electric trains, and has regained the lost patronage. The overhead trolley is used on this road, the trains being made up of two 40-foot cars propelled by four 50-hp motors. Westinghouse air brakes, with electric air compressors, are used.

The overhead trolley is not well suited for this heavy work. It is therefore necessary to return to a device used in the early experimental roads, namely, the third rail. There is now good reason to look forward to the time when electric traction shall be used on railways for long distance haulage. The pioneer work in the application of electric power to standard railway lines is that of the New York, New Haven & Hartford Railroad. No difficulty has been experienced on this road by the open exposure of the third rail midway between the service rails, and it is said that the section hands do not have any trouble from it in repairing track. Many other steam railways throughout this country and Europe have been so greatly encouraged by the success of the experiments on this road that they are taking steps to electrically equip their suburban lines. The Illinois Central Railroad Company has already completed arrangements to operate its trains from Van Buren Street to South Chicago by means of electricity. The Pennsylvania Railroad Company and the New York Central Railroad Company are also said to be contemplating extensive experiments in this direction.

On such roads as these it may be found possible to operate electrically, and instead of the Empire State Express thundering over the rails at the rate of ninety or 100 miles an hour, a train of Pullman coaches may be whirled by electric power over the same track at a speed of 150 miles per hour.

Electricity at the Trans-Mississippi and International Exposition.

The illumination of the grounds and buildings of the Trans-Mississippi Exposition, and particularly of the Grand Court, which corresponds to the Court of Honor at the World's Fair, has been planned on a very lavish scale. Provision has been made for the illumination of all the interiors, the brilliant illumination of the grounds and for all night patrol lighting. The Grand Court and lagoon, with dimensions about 700 x 2500 feet, are to be illuminated solely by 16-cp incandescent lamps, of which some 10,000 will be used for this purpose alone. These will be grouped in clusters or rosettes of sixteen lights each upon 154 white columns set on the capping about the lagoon, approximately 30 feet apart.

The exteriors of the handsome white buildings surrounding the court will be outlined with incandescent lamps, studded around the cornices and under the arches. The entire electrical work has been so vigorously pushed by Superintendent Henry W. Rustin as to justify the assurance of completion for the opening day. Provision has also been made for an ample amount of electric power for the exhibitors, for which the exposition management has put in a complete installation. The charges for power are as follows: For lighting, the rate is $9 for the season for each incandescent lamp, beside the cost of installation, and $72 for each arc lamp of 2000 nominal candle power. For motors a charge of $10 for the installation of one-half-hp sizes, running up to $25 for 10-hp sizes, will be made, in addition to a charge for the power. All current will be supplied from a power house somewhat removed from the main buildings, in order to avoid the marring of the beauty of the latter by any unsightly features. The power house is 170 x 120 feet in size, and contains a battery of four 600 and two 300-hp Morrin Climax boilers, supplying current to a battery of various engines on exhibition, driving General Electric alternators and Brush arc machines. This generating plant was more fully described in The Electrical World of April 30, 1896.

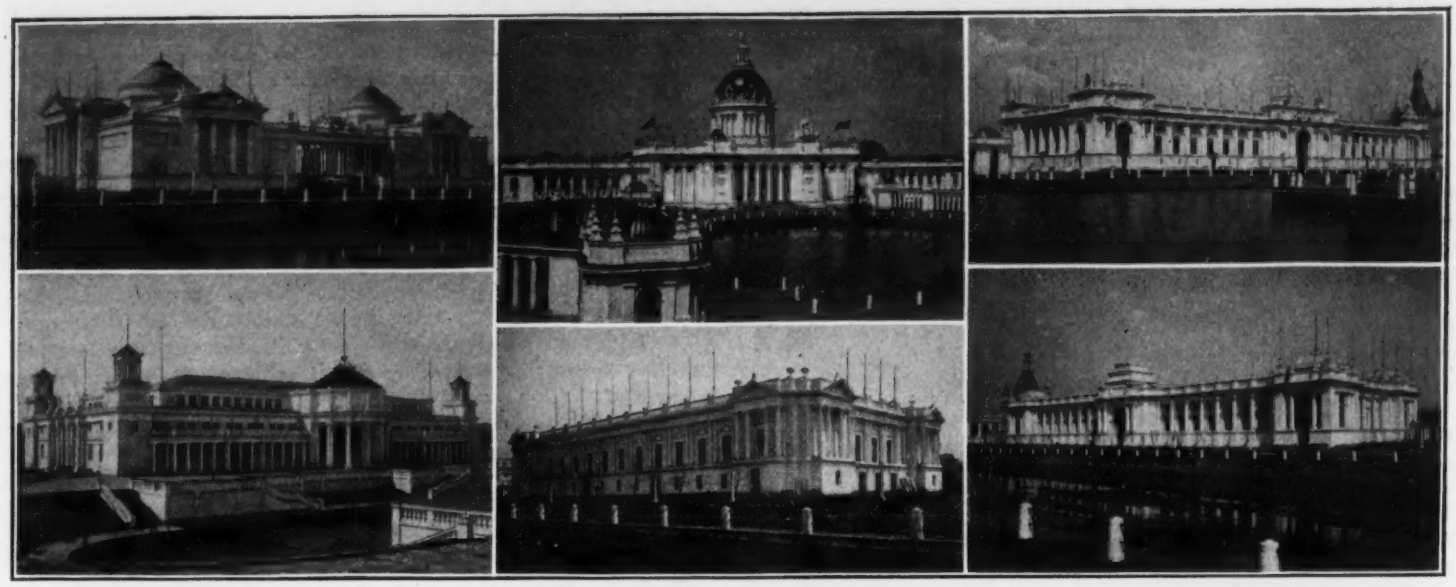
Some idea of the beauty of the buildings about the Grand Court may be obtained from the illustrations. At the west end stands the Government Building. At the main entrance on the south line is what is known as the Arch of States, decorated with a frieze composed of the coats-of-arms of the Trans-Mississippi States, the whole being surmounted by figures bearing the United States shield. The Palace of Agriculture is on the west and the Mines and Mining Building on the east. The canal or basin is spanned in places by bridges built with imposing arches to allow the passage of gondolas and various small boats beneath. The staff work on the buildings will be colored to the tint of old ivory and much classic sculptural carving and statuary of heroic size will be imitated.

Among the officers of the exposition are George W. Wattles, president of the company; Prof. R. B. Owens, of the University of Nebraska, chief of the Bureau of Electricity; Edward Rosewater, manager of the Department of Publicity; and Henry W. Rustin, superintendent of the Electrical Department.

The Trip of the Northwestern Electrical Association.

The following is the schedule of the combined convention and lake trip of the Northwestern Electrical Association. The steamer "Northwest," one of the two most luxurious ships on the lakes, which has been especially chartered for the trip, will leave Chicago at noon, June 10, the day after the adjournment of the convention of the National Electric Light Association. The ship will put into Milwaukee to take on board such members as cannot go to Chicago. Saturday morning a short stop will be made at picturesque Mackinac Island, and Saturday afternoon the ship will reach the mammoth locks of Sault Ste. Marie. A visit is planned to the furnaces now being built there for electrically smelting nickel ore; also to the big plant of the Tagona Company, the carbide works, etc. The ship will remain at the "Soo" until Sunday noon, giving a good opportunity to watch the working of the big locks. Keweenaw Point will be reached during Sunday night and the boat will run into the canal and arrive at Hancock at 4 A. M. Monday, giving an opportunity for a visit during the forenoon to the Calumet & Hecla copper mines. Duluth will be reached during Monday night. A varied entertainment will be furnished by the citizens of that city and a banquet will be held in West Superior on Tuesday night. At noon on Wednesday, the 15th, a special train will be taken for the Twin Cities and Chicago, stopping some three hours in Minneapolis for the inspection of the new hydraulic power plant of the Twin City Rapid Transit Company, and arriving in Chicago early on the morning of Thursday, the 16th. Accommodations for this trip can be obtained from Mr. J. M. Hill, 1240 Monadnock Block, Chicago.

Machinery and Electricity Building.

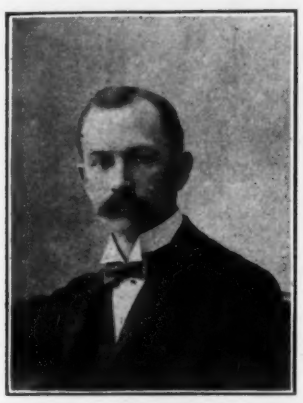


FINE ARTS.
MINES AND MINING.

UNITED STATES GOVERNMENT.
LIBERAL ARTS.

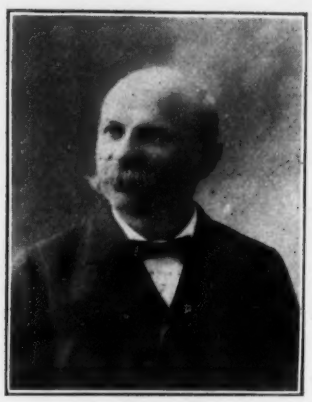
AGRICULTURAL.
MANUFACTURERS'.

BUILDINGS OF THE TRANS-MISSISSIPPI EXPOSITION.



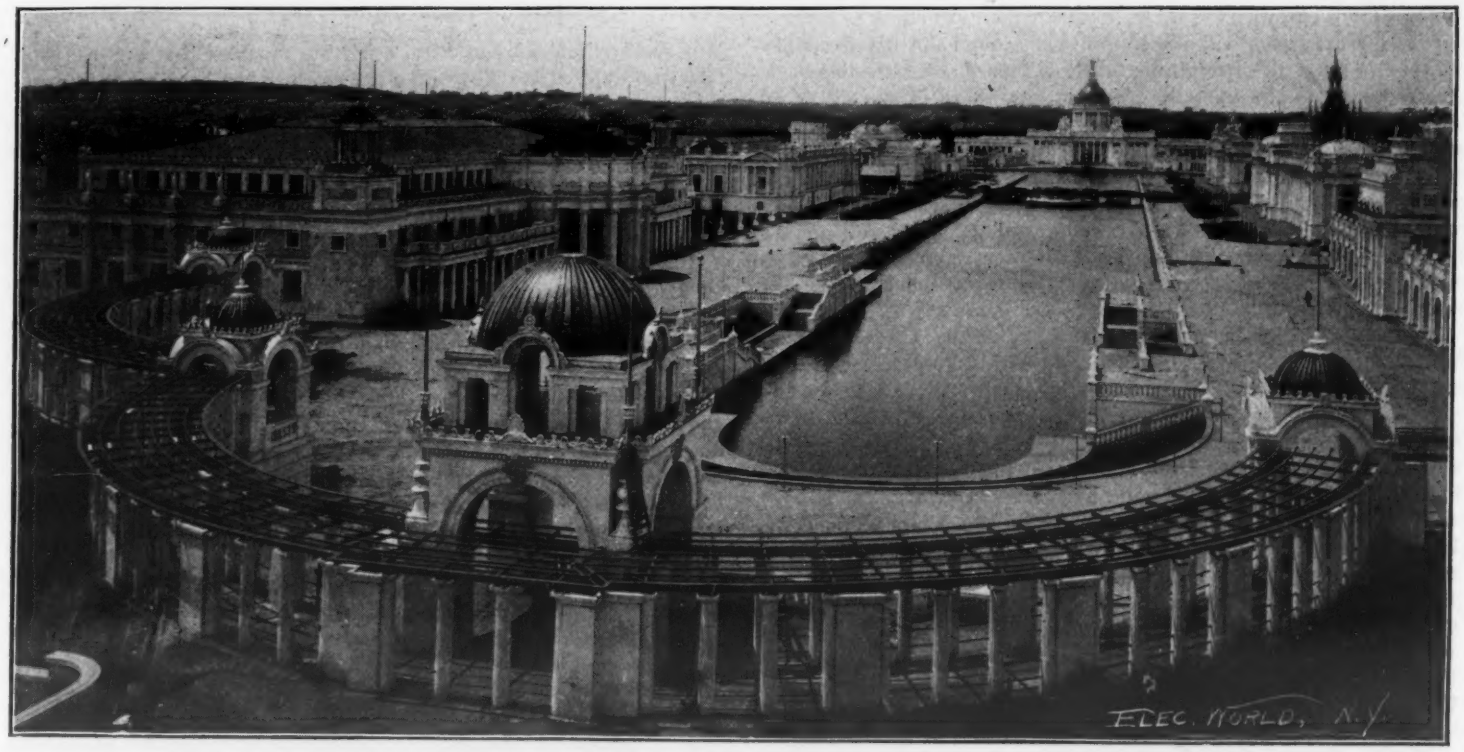
G. W. WATTLES.

R. B. OWENS.



E. ROSEWATER.

H. W. RUSTIN.



LAGOON AND SURROUNDING BUILDINGS, LOOKING WEST FROM VIADUCT.

Oscillatory Currents and Some of Their Phenomena—IV.

BY PROF. E. F. NORTHRUP.

The high frequency apparatus, described above, is unquestionably the most powerful type of apparatus for the production of the X-rays. It has advantages over all other types of apparatus, such as induction coils and friction or Holtz machines, in giving a discharge of great quantity, which is practically continuous. Furthermore, the thickness of the discharge admits of being regulated through a wide range, the length of the discharge remaining unaltered.

With high-frequency currents produced, as described above, to excite the X-rays, the limit as to the quantity of rays which can be obtained is determined solely by the construction of the tube. A tube of any particular construction when exhausted for the production of X-rays is capable of dissipating only a certain maximum amount of energy. If more energy in the form of a discharge of greater quantity is sent through the tube the platinum upon which the cathode rays strike, as well as the walls of the tube, becomes dangerously hot. Obviously, if the high-frequency apparatus has sufficient power to furnish the largest and strongest tube upon the market with the maximum amount of energy which it is capable of taking, and this power can be controlled so that it may be diminished to an amount which smaller tubes require, then the apparatus is suited to every range and variety of X-ray work.

The apparatus described above will do all this.

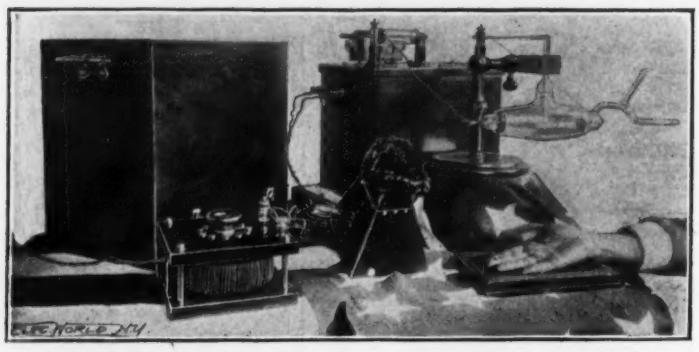


Fig. 17.

The X-rays are now known to be non-homogeneous; that is, as the exhaustion of the tube proceeds new rays are given off which have greater penetrative power than the rays which first make their appearance when the vacuum is lower. For obtaining the most penetrative rays, with which to view the ribs, the hip joint, etc., the vacuum should be very high. If, however, the exhaustion is carried too far the discharge will prefer the path around the glass outside the tube to the path through the tube. If then the distance between the terminals of the tube is, say, 9 inches, there is no object in having a machine to excite the tube which will give a discharge greater than 9 inches. In point of fact the discharge length need not be more than two-thirds of the distance between the terminals of the tube, because the discharge will run a greater distance over the surface of glass than it will through air. A Thompson double focus tube which has the distance between its terminals about 9 inches will be excited by an apparatus giving a 6-inch discharge of large quantity to its utmost limit.

The 8-inch discharge apparatus, described above, if intended only for X-ray work is, therefore, larger than will be required, although on account of the perfect manner in which the discharge may be regulated it will serve well for this work. If the apparatus is intended solely for X-ray work and it is desirable to have it portable, it may be considerably reduced in size over the one described above. Fig. 17 shows an apparatus made by the author which is intended only for producing X-rays and constructed so as to be portable. The picture shows the apparatus with its various auxiliary parts set up ready for taking an X-ray photograph. The box shown on the left of the picture is the case which is used for protection to the apparatus and for transporting it about. The entire outfit, including the variable inductive resistance and case, weighs 147 pounds. The apparatus is constructed essentially like the one described. The discharge gap of the condenser circuit is enclosed in a small box made of blackened brass on the sides and slate ends. Windows in this box allow the double discharge gap to be seen. The tube which appears on the front of the top of the box is to make the discharge through a series gap, which it is sometimes desirable to have in circuit with the tube, noiseless. The inside dimensions of the box are 12 x 8 x 12 inches deep. The transformer is made like the one described above. The condenser is made of thirty plates of glass, 7½ x 11 inches, and twenty-nine thin sheets of copper. The high-frequency transformer is made 6¾ inches long over all. The inside cylinder, on which the secondary of No. 34 wire is wound, sixty-four turns to the inch, is 5¾ inches in diameter. The outside cylinder, on which the primary of ten turns of copper strip is wound, is 6⅝ inches in diameter. The condenser would have been better if made of fourteen sheets of micanite one-thirty second of an inch thick. On 104 volts when the apparatus is giving its thickest discharge it takes less than five amperes. As the discharge is made thinner and more threadlike by adding inductive resistance in the primary circuit the amount of current required is much less. When the discharge has its maximum thickness it will heat the platinum radiant of a Thompson double focus tube white hot in five seconds.

By putting considerable resistance in the circuit of the primary of the high-potential transformer and increasing the length of the discharge gap enclosed in the small box till the discharge will just be able to pass, the high-frequency discharge may be made to simulate

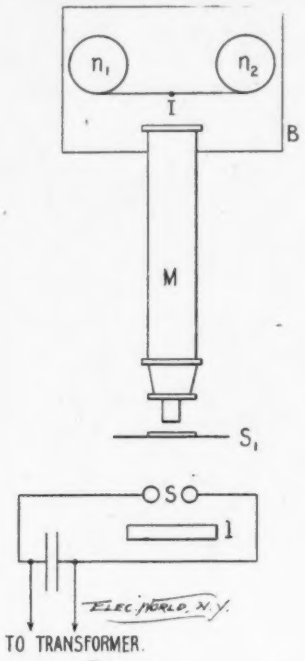


Fig. 21.

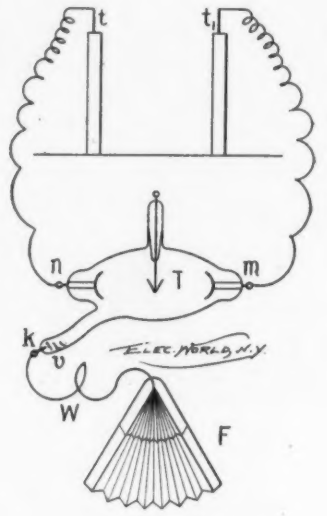


Fig. 18.

so perfectly the discharge from a friction machine that the eye can detect no difference. Now if the transformer had been made like an induction coil and the condenser had been of very much smaller capacity the discharge across the gap in the condenser circuit would have been of the nature of an arc and the high-frequency discharge could not have been obtained without suddenly interrupting this arc by an air blast or in some other mechanical way. I dwell upon this point, since it seems to be the universal notion that the most perfect form of high-frequency discharge can only be obtained by an artificial interruption of the discharge across the gap in the condenser circuit.

Though a discharge through air of 5 inches means a potential difference of about 250,000 volts the physiological effects of the high-frequency discharge are very mild. With an apparatus like the above, having a large condenser, the shock felt by taking hold of both terminals is quite severe, but not at all dangerous to even the life of a cat, as was determined by experiment. If one presents his hand to one terminal, the discharge will go between one-fourth and one-third of the total discharge length between the terminals to reach it, but with the exception of a very slight burn, is not felt. If a piece of metal is held in the hand and presented to the terminal no sensation whatever is noticed. A very severe but probably not fatal shock would be experienced if the current in the primary of the high-frequency transformer were to be passed through the body. It is therefore advisable never to attempt to adjust the discharge gap in this circuit while the machine is in operation.

The limits of this article will not permit of a description of the many striking experiments which can be performed with the high-frequency and high-potential currents. Only a few simple and

easily obtained effects may be mentioned, leaving the reader to pursue this fascinating subject by reading the lectures of Tesla and by his own experimenting.

The chief peculiarity of the high-frequency discharge is its ability to pass to an insulated object from one terminal.

Set the coil working and hold a small piece of metal suspended on a thread within an inch or two of one of the terminals. A fine thread-like discharge will pass to the metal, though this be no larger than a small nail. If the piece of metal is increased in size the thickness of the discharge which passes to it is much increased. Decreasing the distance between the terminals of the coil decreases the discharge to the piece of metal and the distance which it will pass. Thus the discharge to the insulated piece of metal depends for its strength upon the size of the metal piece and upon the air resistance which the discharge between the terminals of the coil has to pass through. This action of the high-frequency discharge finds an important application in regulating the vacuum of X-ray tubes. In Fig. 18 *t t* are the terminals of the high-frequency apparatus, to which the tube *T* is connected. The tube has a projection *v*, in the end of which is some caustic potash and a terminal *k*. *F* is an ordinary paper fan covered with tinfoil to make its surface conducting. *F* is attached by a small wire to *k*. If the vacuum of the tube is very low the potential of the points *n* and *k* is nearly that of the earth, and very little current will flow through the wire *W*. If, however, the vacuum of the tube becomes very high the potential of the points *n* and *k* reaches very high positive and negative values, the changes from positive to negative values occurring with great rapidity. In consequence of this the fan *F* is charged positive and negative alternately with a like rapidity, and a feeble current flows in the wire *W* and through the potash in the neck *v*. This current heats the potash and causes it to give off some of the moisture which is absorbed in it and the vacuum is thereby lowered. The amount of current in the wire *W* can be controlled by closing up the fan, thereby diminishing its surface. Thus by regulating the surface of the fan the vacuum of the tube may be maintained at a point best suited for the production of X-rays. An arrangement of this character will only operate with a high-frequency apparatus.

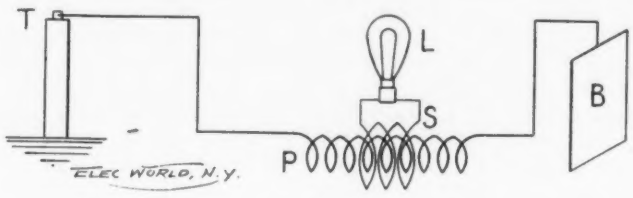


FIG. 19.

Connect a fine wire to each terminal of the high-frequency apparatus. Lead these wires to an insulating support about 10 feet away and adjust the wires so that they are parallel to one another and about 6 inches apart. The current being turned on a beautiful purple sheet of light will fill the space between the wires. In this and other light experiments the room should be darkened to observe the effects at their best. With a powerful apparatus a square metre or more of space may be covered with this purple sheet of electric flame. The effect may be varied by causing a cylinder of light to form between two circular discs of metal connected to the coil with short leads and made to face each other at a distance of a foot or 18 inches apart.

Take a plate of thick glass and paste on opposite sides of it two circular pieces of tinfoil about as large around as a dollar and connect one to one terminal of the machine and the other to the other terminal. The discharge will spread out in streamers some distance over the surface of the glass surrounding the tinfoil discs with a brilliant sheet of light. The high-frequency discharge will not puncture an ordinary window pane at once, but if the two terminals are placed on opposite sides of the pane the discharge spreading out over the surface of the glass will after a short time heat it, when, the glass becoming conducting, the discharge will pass through. The glass shows no hole, but only a spot where it has been melted and again solidified. A 10-inch discharge will in this way eat its way through a cake of paraffin 2 inches thick. If the discharge is passed through a capillary tube the tube becomes brilliantly lighted. If any kind of a vacuum tube is presented to only one terminal of the coil it is quite brightly illuminated. The illumination is much increased by hanging a piece of tinfoil on the free end of the tube. By touching any point of the tube with the finger the illumination of that spot is increased. An incandescent lamp may have its filament brought to incandescence by using only one terminal of the coil in the manner illustrated in Fig. 19. *T* is the terminal of the coil, to which a plate *B* is attached. *P* is a coil of fine wire and around this is wound a coil of a few turns of coarse wire, the ends of which are connected to the lamp *L*. This experiment may be modified in a variety of ways. But the reader who cares to pursue this side of the subject must be referred to Tesla's lectures.

Perhaps of all the striking phenomena of oscillatory currents the most remarkable are the phonomena of impedance which these currents exhibit. To show these arrange matters as shown in Fig. 20. Here *T* is a high-potential transformer, like the one described above. *C* is a condenser, preferably of small capacity. *s* is a double discharge gap, *w* is a heavy copper wire, *l l* are incandescent lamps of high resistance and l_1 l_1 are lamps of lower resistance. When the transformer is working discharges will take place across the air gap *s*, and the high-resistance lamps *l l* will burn more brightly than the lamps of lower resistance, l_1 l_1. These lamps burn in spite of the fact that they are short circuited by the heavy wire *w*. If the lamps are dispensed with and the points p_1 p_1 of the circuit are approached to within a small fraction of an inch of each other while the rest of the circuit to the right of these points forms a loop of some size a discharge will pass between the approximated points of the circuit, which indicates a potential difference between these points of several hundred volts. The wire *w*, which would offer scarcely any resistance to the passage of a direct current, impedes these oscillatory currents as if it were of dry wood.

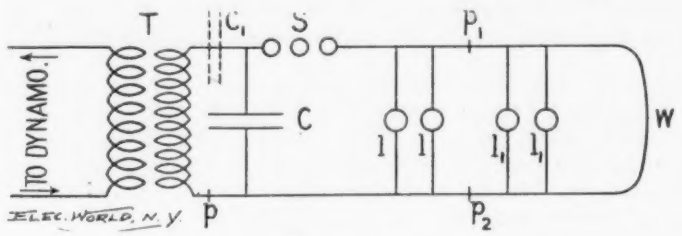


FIG. 20.

These impedance phenomena increase with the frequency of the oscillations, which must be made very great by making the condenser *C* of small capacity and the circuit of wire short. A Leyden jar will answer very well for the condenser and an induction coil may be used for the transformer. In this case, however, a continuous arc is apt to occur at the discharge gap, and as the resistance of an arc is small the condenser will not be highly charged and the oscillations will be poor. This difficulty may be overcome either by blowing out the arc with a moderate blast of air or sometimes by inserting another condenser, C_1 (shown in dotted line), in the circuit. This condenser should have a little greater capacity than the condenser *C*. In this way *C* can become charged to its full capacity while C_1 holds back the current from the transformer so that a flaming arc cannot occur across the discharge gap. In this and other experiments on the oscillatory discharge it is desirable to arrange matters so that the condenser in the circuit carrying the oscillatory discharge is supplied with electricity from the transformer more slowly than it empties itself of its charge when the air of the discharge gap breaks down. In this case the low-resistance arc at the gap is automatically broken. It is hard, however, to say just what conditions are required to produce the best oscillations in any particular case without blowing out the arc. This would be a very useful matter to experiment upon till the principles are determined clearly which govern the automatic interruption of the arc. It may be that adding a suitable ohmic or inductive resistance at the point *P*, Fig. 20, would serve the same purpose as the condenser C_1.

No mention has been made of the use of iron in the coils to increase the inductive action between a primary and a secondary circuit. A simple experiment will show why iron cannot with advantage be used. Take a glass tube and wind on it a few turns of wire and send through this wire, which will correspond to the primary of the high-frequency transformer, an oscillatory current. If now a fine iron wire is inserted in the tube it will in a few seconds become too hot to handle. A large number of wires put in the tube will also become very hot, but not so quickly as one. This

heating of the wires is probably due not only to hysteresis or molecular friction, which resists the rapid reversals of the magnetization, but also to currents which are induced in the metal. Heating of the iron represents a great loss of energy and as the inductive effects can be obtained without it nothing is to be gained by its use.

If the circuits are arranged like that shown in Fig. 1, the condenser being made of about fifteen glass plates a foot square, and the wire w is not over 6 inches long, when the oscillatory discharge is passing the short wire w, even if it is as large as No. 14, will become sufficiently hot to burn its insulation, while the No. 32 wire of the transformer supplying the energy to the transformer remains perfectly cool. This indicates that a very large current flows in the condenser circuit when oscillations are taking place. The discharge through the gap is entirely different in character from what it is when no condenser shunts the gap. In the latter case it is a species of flame, having a yellow hue and nearly noiseless. In the former case the discharge becomes very noisy, extremely brilliant and very blue. By waving a stick in the light of the discharge the light is seen to be discontinuous, as the moving stick gives rise to a large number of multiple images. As the balls of the gap are more and more separated the intervals between the separate discharges become greater. This light undoubtedly has powerful actinic properties, and the idea suggests itself that kinetoscopic views might be taken with its aid, especially of moving microscopic objects. An arrangement something like that shown in Fig. 21 might be adopted.

Here S is the discharge gap, giving rise to the brilliant rapidly interrupted light, l is a condensing lens, S_1 is the slide of the microscope containing the moving microscopic object, M the microscope; N_1 N_2 are two rolls, on which a sensitive film runs, B a box to exclude light. The microscope can be easily arranged to throw the magnified image on the film at I. If the film be now rolled from one roll to the other while the rapidly intermittent discharge is passing at S, kinetoscope views ought to be obtained on the film without great difficulty. At any rate the brilliant and intermittent character of the light ought to find useful application in some way similar to the above.

Transformer Regulation.

BY A. R. EVEREST.

The "regulation drop" in a transformer is a drop in voltage at the secondary terminals of the transformer when delivering current, due to internal losses in the transformer itself, the primary voltage remaining constant.

Apparently the easiest way to determine the regulation of a transformer would be by direct measurement of the voltage at the secondary terminals; first, when the transformer is carrying no load, and secondly, when the transformer is carrying full load, the difference between the two being the regulation drop, provided the primary voltage is kept constant.

In practice, however, this test is attended with a number of difficulties, so great in fact as to render the test perhaps the most difficult and unsatisfactory of all transformer tests. Even when the voltage on the primary side is observed by an independent voltmeter (and step-down transformer) it may frequently happen that the temperature coefficients of the two voltmeters are not alike, producing discrepancies in the readings which in themselves small, produce a large percentage error in the quantity to be finally determined.

Absolutely steady readings are also desirable for the success of this test—a condition which is very seldom attained. The pulsations of a slow-speed engine reflected on the voltmeter needle are often sufficient to make the test absolutely worthless.

There are several other minor factors which tend to disturb this test. Most of them can be met independently, as by exchanging voltmeters between readings, by taking large numbers of readings at each point and averaging results, and so on; but experience continually shows that with the greatest care the results obtained by this method cannot always be relied upon.

Perhaps the hardest point of all in connection with the regulation test as commonly made is the difficulty of persuading the station electrician who makes his own tests that his results (often absurd) are open to question.

But since the losses creating the "regulation drop" in a transformer can be independently measured, the calculation of the regulation from these observed losses becomes a simple matter.

The "regulation drop" in a transformer is caused by two losses. First, the energy loss, or C. R. drop in the transformer windings; secondly, the reactive drop, or "inductance" of the transformer. In certain special cases we must also take into consideration the effect of the magnetizing current in the primary, since when the latter is relatively large it produces a phase displacement between the primary and secondary currents and has the same effect on regulation as an increase in the reactive drop.

When this phase displacement is so small as to be insignificant the calculation of the drop of the transformer is reduced to the resolution of a right-angle triangle.

We draw for the base line the total energy drop, including that in the transformer and in the external circuit.

Perpendicular to this is laid off a line representing the reactive drop in the transformer. (We are here assuming that the external load is non-inductive.)

The hypotenuse joining these two sides of the triangle now represents the primary applied voltage. We may call this 100 per cent.

If the reactive drop is, say 3 per cent., the horizontal becomes the square root of 100^2 minus 3^2, or, roughly, 99.2 per cent.

If the known C. R. drop in the transformer amounts to 2.2 per cent. we have left 97 per cent. voltage (= 99.2 per cent. — 2.2 per cent.), at the secondary terminals, as compared with the primary input, or in other words there is 3 per cent. regulation drop in the transformer.

In many cases however, especially when testing an unknown transformer, it is necessary to take into account the effect of magnetizing current. The calculation is then not quite so simple, but by means of the method shown below the determination can be made with the greatest accuracy. This method has the advantage of appealing directly to the eye by means of the well-known "transformer diagram."

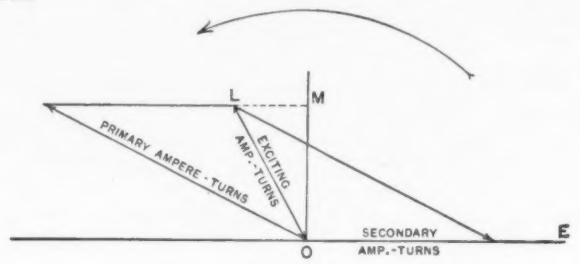


Fig. 1

The vectorial diagram in Fig. 1 shows the relative directions of secondary current, primary current, and resultant magnetizing force and flux.

$O\ L$ is the primary exciting current at no load. It consists of two components, $O\ M$ the true magnetizing component in phase with the flux $O\ M$; and $M\ L$ at right angles to this, which is the energy component, representing the energy expended in core loss.

When the secondary circuit is closed the primary current will adjust itself in magnitude and direction so as to maintain the vector $O\ L$ as resultant of primary and secondary magnetizing forces.

The magnetic flux $O\ M$ generates in the transformer windings a voltage $O\ E$, 90° behind the flux in phase. This is the active voltage of the secondary circuit, and also appears as a counter E. M. F. in the primary circuit, where it is shown as $O\ I$. (Fig. 2.)

It is here assumed that the secondary circuit is non-inductive, hence the secondary current is in phase with the induced E. M. F. $O\ E$. (For simplicity we also assume that the transformer has a 1 : 1 ratio). The voltage impressed on the primary to maintain the secondary current must be the resultant of three components (Fig. 2):

$I\ O$, opposing counter E. M. F. 90° ahead of flux $O\ M$.

$D\ I$, overcoming primary C. R. drop in phase with primary current.

$R\ D$, opposing reactive drop, and 90° ahead of primary current.

The resultant of these is $O\ R$, which is primary impressed voltage.

It will be noted that this primary voltage $O\ R$ is really the resultont of *two* values, $R\ I$ the primary impedance drop, and $I\ O$ the secondary induced E. M. F. If we can calculate these, and know the sec. C. R. we have the regulation at once.

It will be observed that any increase in magnetizing component increases the lag between primary current $O\ P$ and counter E. M. F. $O\ I$. Since the base line $I\ D$ of primary impedance triangle (the C. R. drop) must be always parallel to $O\ P$ (the primary current) it

follows that an increase in magnetizing component will swing the primary impedance vector *I R* more into phase with the secondary induced volts *I O*, increasing the value of the primary impressed voltage *O R* for any given secondary voltage.

If the diagram is plotted on squared paper with sufficient accuracy the regulation can be obtained at once from Fig. 2, since when *O R* is primary impressed voltage *O I* is to same scale secondary induced voltage, and may be expressed in per cent. of the former. Deducting the secondary C. R. drop in per cent. we have the percentage of primary voltage appearing at secondary terminals.

But for greater accuracy it is preferable to calculate the side of the diagram.

Let in Fig. 3 the vectors *I D* and *D R* be replaced by *I J* and *J R*, the vector of primary impedance *I R* remaining unchanged.

From the known values of primary impedance, C. R. and reactance, the angle, α, of the impedance triangle is known. The corresponding angle *J I R* = β of the new triangle is equal to α reduced by the small angle *J I D*. But this latter angle is the angle of lag between primary current and counter E. M. F. and is readily found from the known values of exciting and full load current. (A tabulation of the lag angle for values of exciting current from 5 per cent. to 20 per cent. is given further on.)

Having found the new angle, β, and knowing the value of primary impedance, the new vector *J R* (which we may call equivalent reactive drop) is found as the sine of the angle β, and the vector *I J* (or equivalent primary C. R.) is cos of same angle.

Having expressed all the values in per cent. of primary voltage for convenience, we now resolve the right angle triangle *O R J*, taking *O R* = 100 per cent., *R J* = equiv. react. drop per cent., and obtain *O J*, which is secondary terminal volts per cent. + sec. C. R. per cent. + pri. equiv. C. R. per cent. Knowing the last two values we at once have the per cent. of primary voltage appearing at secondary terminals, and therefore the *regulation* of the transformer.

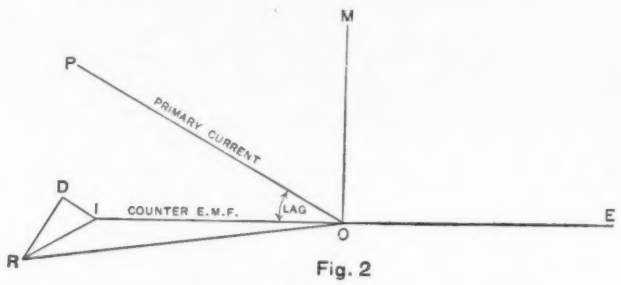


Fig. 2

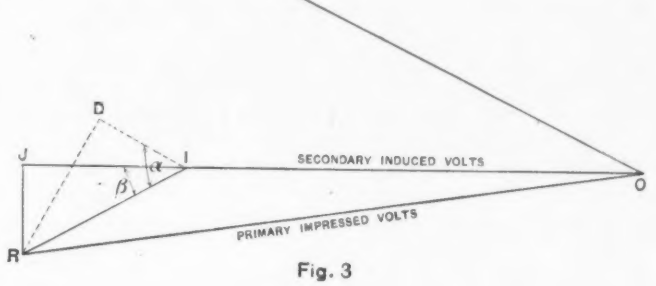


Fig. 3

As an illustration, the method will be applied to the determination of regulation drop at full load of a transformer on which the following measurements are known:

(The measurements of copper loss and impedance drop are made by means of a wattmeter, the secondary of the transformer being short circuited, as described in Dr. Bedell's paper on transformer regulation, published in THE ELECTRICAL WORLD.)

Capacity of transformer, 2500 watts.

Ratio of transformation, 10 : 1.

Primary voltage, 1000; frequency, 125 cycles.

Copper loss ($C^2 R$), 50 watts.

C. R. drop, 2 per cent.

Impedance drop, 54 volts = 5.4 per cent.

Iron loss, 60 watts.

Exciting current (no load current in primary at 1000 volts) .125 amp.

TABLE OF PRIMARY CURRENT LAG.

Per cent. exciting current.	Angle of lag.
5 per cent.	2.0°
8 " "	3.5°
10 " "	4.5°
12 " "	5.0°
14 " "	6.0°
16 " "	6.5°
18 " "	7.5°
20 " "	8.0°

This table is not correct for frequencies below 50 cycles.

The lag angle of primary current behind counter E. M. F. line is determined from the relative values of primary exciting current and primary full load current. For convenience, the lag angles are tabulated above for values of exciting current from 5 per cent. to 20 per cent. on the assumption that the magnetizing component is 80 per cent of the exciting current. (This is sufficiently accurate for all ordinary transformers on frequencies of 50 cycles and above. The value increases, tending toward 100 per cent., with the large exciting currents accompanying very low frequencies):

In the case under consideration, we have exciting current 5 per cent., lag angle, 2°.

The total impedance drop is 5.4 per cent., the C. R. drop, 2 per cent., and reactive drop $\sqrt{5.4^2 - 2^2} = 5$ per cent.

The *primary* impedance drop is resultant of reactive drop and primary C. R. drop, which we may take as one-half of total C. R. drop. It is therefore $\sqrt{5^2 + 1^2} = 5.1$ per cent.

In Fig. 2 we then have *I R* = 5.1 per cent.

I D = 1 " "

D R = 5 " "

To find the angle *R I D* we find what angle has its sine (*R D*) $= \frac{5}{5.1} = .981$. The angle is 79°. (See angle, α, Fig. 3).

Deducting from this the current lag angle we have for the angle, β, 77°.

J R is the sine of this new angle and is $.974 \times 5.1 = 4.96$ per cent.

Similarly *J I* is the cosine of 77° and is in value $.225 \times 5.1 = 1.15$ per cent.

To determine the regulation we now resolve the right triangle *R O J*:

R O = 100 per cent.

R J = 4.96 per cent.

J O = $\sqrt{100^2 - 4.96^2} = 99.87$ per cent.

Deducting *J I* — 1.15 per cent. we have 98.72 per cent. as secondary induced voltage (*I O*) and deducting again secondary C. R. drop, 1 per cent., we have 97.72 per cent. of primary applied voltage appearing at the secondary terminals or a regulation drop of 2.28 per cent.

It is of interest to note here that figuring the regulation of this transformer by the simpler method first described, entirely ignoring the effect of exciting current, the result gives 2.13 per cent. regulation drop, a difference of 0.15 per cent. due to 5 per cent. exciting current. With a larger reactive drop in the transformer, other losses being equal, the difference between results obtained by the two methods would be somewhat greater.

Calculated by Dr. Bedell's method before referred to the regulation drop obtained is 2.44 per cent., slightly higher than that by the method above. This is due to the fact that Dr. Bedell's method assumes that the magnetizing current is equal to the exciting current, which is not the case, and also in a slight degree to some other minor approximations adopted in the construction of his diagram.

The percentages of iron loss and exciting current taken in the above illustration are higher than would be found in good modern transformers of any but the smallest sizes, but they have been purposely taken here to illustrate the point under discussion. For the same reason the diagrams are greatly exaggerated. In actual practice the primary current line *O P* is very nearly parallel with the line *O I*.

A Vest Pocket Furnace.

Professor Ostwald, the noted German electro-chemist, in referring to the very interesting discovery of Goldschmidt, which was described in our "Digest," last week, gives the apparatus the appropriate name of a "vest pocket blast furnace."

The Shaft Governor.

BY THOMAS HALL.

Though the modern shaft governor is a very simple appearing mechanism, it is by no means an easy matter to weigh correctly the many important considerations which present themselves to the designer. The development of the electric light and power plants of recent years, especially in the United States, has called for a class of engines hitherto almost unknown. Nearly perfect regulation is demanded of the engine builder. He must be able to guarantee that the extreme fluctuation of speed shall not be more than 2 per cent., though the load may vary from zero to the maximum capacity of the engine.

In order to more consistently show a few of the problems which present themselves in the endeavor to secure good regulation a simple illustration will be given; see Fig. 1. Let O represent the point of attachment of the weight lever to the fly wheel, D the outer, and C the inner positions of the centre of gravity of the governor ball, B and A the corresponding points of the spring connections to the lever arm, S the centre of the shaft, and K the point at which the spring is fastened to the fly wheel. Centrifugal force $F = 1.22\ W\ N^2\ R$; in which W = the weight of ball, V = the velocity of ball in feet per second, R its distance from the centre of the shaft in feet, and N the number of revolutions per second. Knowing the number of revolutions, the distance of ball from the centre of the shaft, and the necessary centrifugal force to handle the valve of the engine in question we readily determine the weight of the ball by substitution. From the above formula we see that centrifugal force varies directly as R for isochronism. Let us assume that the necessary centrifugal force for the outer position is 1600 pounds; its line of action is $S\ D$ and its lever arm the perpendicular $O\ E = 15.2$ inches; then the centrifugal moment for position D is $1600 \times 15.2 = 24{,}320$ inch pounds, which must be balanced by the spring pull at D multiplied by its lever arm the perpendicular $O\ F$, let fall on the line of the spring. Hence the pull of the spring at $B = \frac{24{,}320}{7.44} = 3270$ pounds. If we assume the same speed at C as at D (centrifugal force being proportional to R) the centrifugal force at C will be 533.3 pounds and its lever arm $O\ G$ is 13.6 inches, hence the centrifugal moment for the inner position is $533.3 \times 13.6 = 7250$ inch pounds. This must be balanced by the spring pull at A multiplied by its lever arm $O\ F$, hence the spring pull for this position $= \frac{7250}{7.44} = 976$ pounds. The spring has shortened by $A\ B$ or 6 inches and the spring pull is less by $3270 - 976 = 2294$ pounds, hence the force required to stretch the spring 1 inch is $\frac{2294}{6} = 382.3$ pounds, commonly called the "unit strength," or scale of the spring. In order that the spring may have the proper initial tension, "that is, when the engine is standing and the governor balls resting against the stop at the inner position," the spring must be stretched $\frac{976}{382.3} = 2.55$ inches. Because of this initial tension the balls will remain in this position when the engine is started up, until the normal speed of the engine is reached, thus giving the maximum cut-off. Any further increase in speed will, due to increase of centrifugal moment, cause the balls to leave the inner stop and take up a new position, where the spring and centrifugal moments again balance and thus shift the eccentric centre to give an earlier cut-off.

If, throughout the entire range from C to D the centrifugal moment exactly balances the spring moment for the normal speed of the engine we have an isochronous governor. Any increase of speed will cause the ball to fly to the extreme outer position, and any decrease beyond the normal will cause it to fly to the extreme inner position. Not only would changes of speed cause this "racing" between extreme positions, but any third force would tend to cause it, for example, the drag of the valve, friction or gravity action. The moment of these forces acts alternately with and against the spring moment, and thus they throw the governor out of equilibrium. This "racing" between extreme limits causes cut-off to change correspondingly, even though there be but very little change of load on the engine. Evidently then this is a very "unstable" and undesirable form of governor.

In order that we may obtain "stability" with this type it is necessary that a slight increase of speed be allowed between the inner and outer stops. To accomplish this we would choose a spring a little stronger than the above and give it less initial tension, such that at about the mid position of the ball the spring and centrifugal moments would be equal for the normal speed of the engine. For any point nearer D the spring will have the advantage and can only be balanced by the centrifugal force at some speed above the normal; toward C it will be balanced at a lower speed. With this combination it requires either some disturbing force or a change of speed to shift the ball; this then is a "stable" governor.

The greater the disturbing forces the further we depart from good regulation, hence the necessity of light balanced valves, the elimination of gravity action and the reduction of governor friction to a minimum.

Suppose instead of choosing as we did a stronger spring we had selected a weaker one and given it sufficient initial tension to balance centrifugal force at the mid position, what would have been the action of the governor? It would have less "unit strength" and for the normal speed would be too weak for all points outside the mid position and too strong for all points nearer the shaft. Any increase in speed then would cause the ball to fly clear out against the outer stop, where the centrifugal force would have a decided advantage. Here it would remain until the speed due to too early

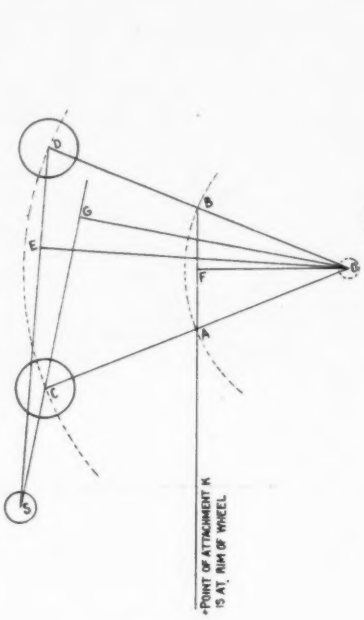


Fig. 1.

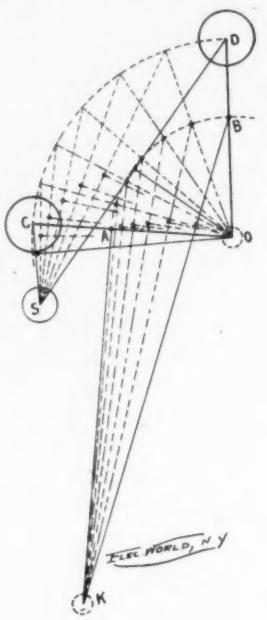


Fig. 3.

cut-off fell off considerably below the normal, thus lessening the centrifugal force until its moment and that of the spring balanced; any further decrease of speed would tend to cause the ball to fly to the inner extreme, where the spring would have a decided advantage and would hold the ball there until the speed had increased considerably beyond the normal, when it would again tend to fly to the outer extreme. This would constitute a very "unstable" form of governor, and would intermittently tend to throw the cut-off clear from the minimum to the maximum, then back again to the minimum and so on, causing a very considerable fluctuation of speed. Such an arrangement would cause a higher average speed of the engine for heavy than for light loads.

To sum up the above, then, if we use a spring which will just balance the centrifugal force for all positions at normal speed when given the proper initial tension we have an isochronous arrangement, but one which is "unstable" and certain to "race," due to valve drag, friction, change of load, gravity, etc.

If a spring having less "unit strength" is used and more than full initial tension we have a combination still more "unstable" and equally certain to "race," while the fluctuation of speed will usually be considerable.

By using a spring stronger than that required for perfect isochronism and giving it less than full initial tension "stability" is secured; the greater the unit strength of this spring the more "stable" the governor, and the greater the increase of speed between light and full load.

Both "isochronism" and "stability" are desirable; that is, we want a governor which will not allow the engine to change in speed and yet we do not want it to race. Unfortunately, however, they are antagonistic, the nearer we approach isochronism the more unstable the governor. In practice the designer is compelled to compromise between the two. The more stable the governor the greater the change between light and full load, but the less will it be disturbed by friction, gravity or valve drag. The stability and centrifugal force of a governor are a measure of its "strength," then if we want to handle a heavy unbalanced valve we must have heavy weights and considerable stabilty. The term "hunting," though frequently applied to both the unstable and stable forms when in action, would seem more properly applied only to a governor having stability. If a governor be adjusted close to isochronism any disturbing force or change of load tends to throw it beyond the true position, when it will surge back again and oscillate about the true position as does a pendulum until dampened down by resistance, such as friction, etc. In other words the governor is "hunting" for the true position. This term would not seem applicable to the weak spring case we have mentioned. The oil and air dash pots were introduced in order to check this racing action and would undoubtedly prove desirable, enabling us to adjust closer to isochronism were it not for unavoidable accompanying friction, which is a deadly enemy to good regulation. If we attempt to build a strong governor of the above type, add a dash pot, and adjust close to isochronism, we must necessarily have heavy balls and consequently heavy springs,

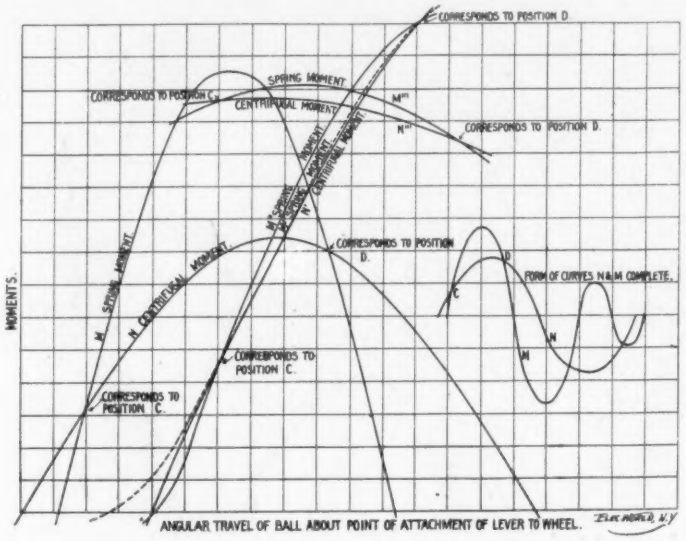

CORRESPONDS TO POSITION D.
SPRING MOMENT
CENTRIFUGAL MOMENT
CORRESPONDS TO POSITION C.
CORRESPONDS TO POSITION D.
CORRESPONDS TO POSITION D.
FORM OF CURVES N & M COMPLETE.
CORRESPONDS TO POSITION C.
CORRESPONDS TO POSITION C.
MOMENTS.
ANGULAR TRAVEL OF BALL ABOUT POINT OF ATTACHMENT OF LEVER TO WHEEL.

FIG. 2.

thus producing heavy pressure on the bearings, which results in increased friction. A small decrease in the amount of friction where possible is better than an increase in weight of balls and in strength of spring. Friction is reduced by lessening the number of joints, as has been done in some of the modern forms of shaft governors.

Suppose a governor having considerable friction and running at the normal speed; when the load decreases or increases the speed will change correspondingly; the governor will not respond at once, as it should, but will do so only when a sufficient change of speed has taken place to overcome the friction. This undue change of speed will cause the balls to throw beyond their true adjustment, "causing cut-off to change likewise." Here they will again be held by friction until a sufficient change of speed again occurs to shift them. The result is racing and an undesirable fluctuation of speed.

As previously stated the valve drag has a moment about the fixed point of the lever arm O which alternately assists and resists the centrifugal moment. The average resistance, however, overbalances the average assistance, hence the effect of this drag, on the whole, is to pull the balls slightly inside of the true position, thus causing the engine to run at a speed somewhat greater than that for which the governor was designed. If the same governor be used on two engines which are exactly alike except that the one has a light balanced valve while the other has a heavy unbalanced one, the latter will be found to run considerably faster than the former, due to the valve drag and inertia of valve. Professor Barr, of Sibley College, has made an interesting investigation of this action, the results of which will probably constitute the subject matter of a paper to be read before the American Society of Mechanical Engineers within the next year.

During 180° of the revolution gravity action has a moment about the point of lever attachment in one direction and during the next 180° in the opposite direction, the extent of which moment varies as the ordinates of a sinuous curve. In the one case this gravity moment assists and in the other retards centrifugal action. In some types, as the Straight Line, for example, gravity action is practically eliminated.

In others, as the McIntosh and Seymore and former Ball type, the valve drag moment is practically overcome. If gravity action and valve drag moment could be entirely overcome it is doubtful if it would be advisable, at least in a governor having considerable friction, for the reason that a small amount of this action tends to keep the governor "alive," ready for any emergency.

The varying tangential effort on the crank pin, of course, causes the speed of rotation to slightly vary during each revolution, which action, due to the inertia of the governor weights, tends also to keep the governor alive. This action, if not too great, has exactly the same effect upon the governor as has the tapping of a steam gauge when you desire an accurate reading. In other words, it makes the governor more "sensitive" in response to changes of load.

Thus far we have assumed that it is possible to get perfect isochronous adjustment. Such is possible only when the point of attachment of the spring to the wheels is on the line $O\,S$, Fig. 1, when the point of attachment B, of the spring to the lever is on the line $O\,D$, joining weight and point of attachment of lever, and when the zero of extension of the spring brings the point B to coincde with the point of attachment of spring to wheel on the line $O\,S$; or when these two points of attachment of the spring are at the same angle with $O\,D$ and $O\,S$, having rotated them about O in the same direction and through the same angle. Such an arrangement is hardly possible in an actual governor, so that it is necessary to so select points of attachment, etc., as best approximate this condition, as, for example, the arrangement shown in Fig. 1, the point K being so chosen that the line $B\,K$ will pass through A. If we desire to approximate isochronism we cannot choose the point K at random, for though in any case we may have equilibrium at C and D between the spring and centrifugal moments for normal speed, such may not by any means be the case for all intermediate points, so that it becomes necessary to examine the moment curves, if we wish to know what changes of speed will take place throughout the range. The curve of moments is a sinuous form of curve, as is shown in Fig. 2. The curve of spring moments may take different forms, depending upon the spring chosen and upon the location of the points of attachment. These curves are plotted by laying off moments on the vertical and angular movement of the ball about the point of attachment of its lever arm to the wheel on the horizontal. N and M, Fig. 2, are the form of curves obtained from the arrangement shown in Fig. 3, which is rather an extreme case. The great difference between the spring and centrifugal moments would permit the engine to run at a much higher speed for medium than for light or full load. With the arrangement as shown in Fig. 1, however, we obtain curves N' and M', which very nearly coincide throughout the entire range between extreme positions C and D. The greatest increase of speed for medium load in this case would be one revolution, with a normal speed of 280. With the arrangement shown in Fig. 4 and spring attached at K', substantially the same curves N' and M' are obtained, but if the point of attachment be shifted to K, thus placing the spring obliquely, curve M'' of spring moments is obtained, which would allow a maximum increase of speed for intermediate positions of about eleven revolutions, so that for early cut-offs the engine would run at 280 and would gradually increase to a maximum of 291 revolutions as the load increased to medium load, and then fall off again to 280 as full load is reached. As the engine reached the maximum speed of 291 for medium load any further increase in speed would tend to cause the balls to fly to the outer extreme, since the spring is too weak at the outer positions for this speed. Here the balls would remain until the speed had fallen off considerable, again establishing equilibrium between the moments for this outer position. Any further falling off in speed would cause the balls to move inward too far on account of the spring moment having the advantage for intermediate positions at normal speed. This arrangement would give a stable governor when the engine was working

inside of medium load, though allowing a considerable change in speed, while for loads greater than this the governor would be unstable. In the design of a governor these moment curves should be made to coincide as nearly as possible throughout the entire range.

To take an actual case of a type of governor used quite extensively see Fig. 5 for general arrangement. The curves M''' and N''', Fig. 2, show the moment curves. The greatest difference between the two will permit of an increase of speed of about 5.5 revolutions per minute for a normal of 280. The arrangement of a great many governors is such as will permit of at least as much variation as this.

A racing governor or one allowing more than 2 per cent. variation in speed is undesirable for electric light service, since the brightness of the lights will vary correspondingly. A considerable instantaneous change of load is usually more or less noticeable in the lights. A very great instantaneous change is prevented by the inertia of the fly wheel, and the greater the weight of the fly wheel the less will be the magnitude of the change but the greater its period of duration. With governors of good design and moderately

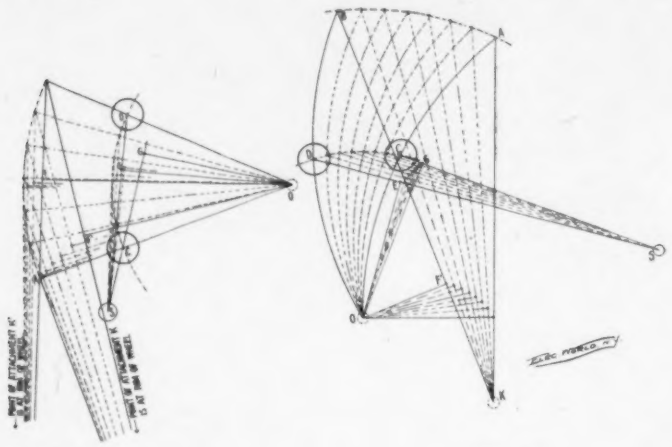


Fig. 4.

Fig. 5.

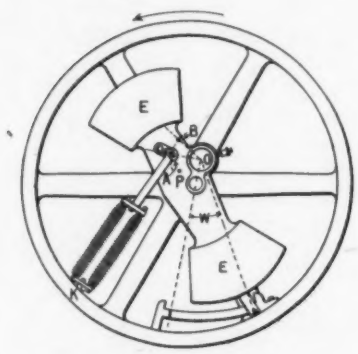


Fig. 6

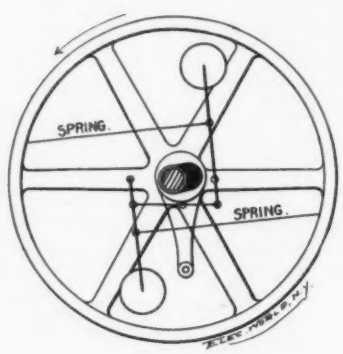
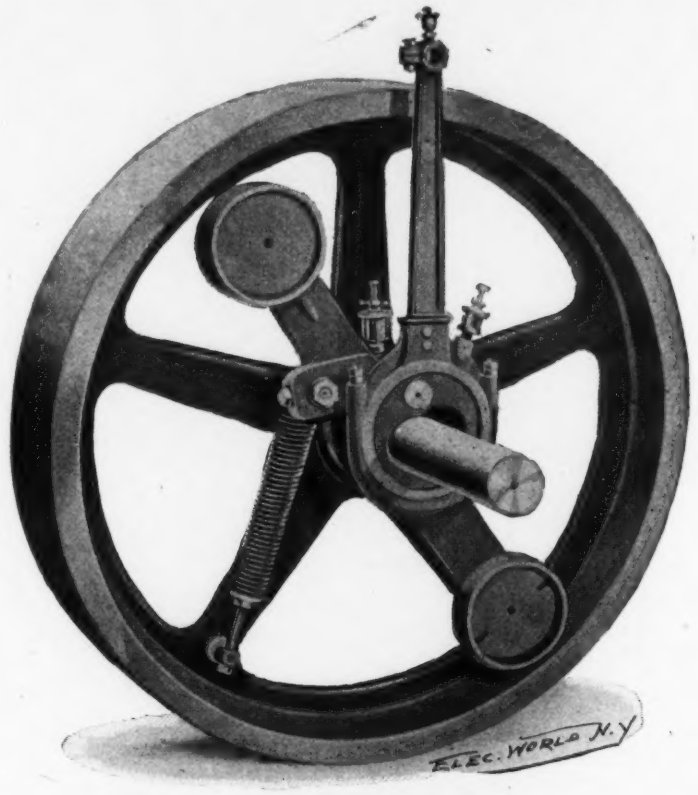


Fig. 7.



View of a Representative Inertia Governor.

heavy fly wheels the instantaneous change is frequently as great as 5 per cent.

The computations in design may usually be based on isochronous action throughout the entire range; and the ordinary adjustments, together with the necessary approximations, will generally be sufficient to obtain the required stability. Computations, however, may be based on an allowable increase of speed between zero and full load of say 2 per cent. for cases requiring close regulation.

When a governor of good design is found to work imperfectly the difficulty will as a rule be found to be due to friction or some fault of the spring, which may be too weak, too strong or may not have the proper amount of initial tension. These faults can be determined and generally located by means of a good tachometer and an indicator.

Numerous devices for making the governor respond more readily and quickly have been employed. Among these the modern forms of the inertia type are the most successful. The Rites type, see Fig. 6, of inertia governor has already been adopted by thirty-five high-speed engine builders throughout the United States; a modification of it is also being taken up by the Corliss engine builders of this country, which is ample proof of its excellence. The weights E and E' are usually cast hollow so as to be able to weight them and bring the centre of gravity P at the desired point on the axis of the bar. If A and B are the two extreme positions of the point of attachment of the spring to the bar the point K should be so chosen that the line $B\,K$ will pass through A, which will be in accordance with the principles to which we have previously referred. The weight of the bar is arbitrary; the greater this weight the greater will be the inertia action. A certain amount of centrifugal force, however, is indispensable. This amount it is practically impossible to determine except by experiment. The above discussion relating to too weak or too strong a spring and improper initial tension equally applies to this type. Let us suppose a sudden change of load to occur, what will be the action of this governor? Suppose the load to have decreased the wheel will jump ahead, while the heavy bar will, due to its inertia, lag back and act in harmony with centrifugal force, thus adjusting the valve to an earlier cutoff. If on the other hand the load suddenly increases the wheel will be checked, while the heavy bar tends to continue at the same velocity, acting with diminution of centrifugal effort to shift the eccentric to a later point of cutoff. By following this action through, the reader will readily see that for rotation in the opposite direction to that indicated, inertia would oppose centrifugal action. For very gradual changes of load the centrifugal force must largely take charge of the valve, as the inertia effect would then be very slight. The smaller the arc W the more promptly will adjustments of the cutoff be made. If the magnitude of this arc be made too great the inertia action may actually retard centrifugal adjustment. This governor gives remarkably close regulation when properly designed and adjusted. On account of the great portion of the weight of the bar being so far from the centre it is very strong in its action, permitting a closer opproximation to isochronism than most governors, and consequently approaching nearer to a uniform speed throughout its entire range. Comparing governors of the same sized engines we find this type has much less centrifugal moment than any other and yet it is equally stable, if not more so, because of the fact that the disturbing forces have less control over it and friction has been reduced to a minimum, there being but one joint. The stability of this type might be illustrated by the tight rope walker's bar. This bar is always of considerable length, having two heavy weights at the outer ends. The performer may counteract a tendency to fall by exerting an upward force with one hand and downward with the other; the inertia moment of the balls being very great, he thus saves himself from falling. If the bar were short and the balls of

the same weight it would be of little service to him, because of the greatly lessened inertia moment. Just so is it with this type of inertia governor. The disturbing forces in order to have any effect must accelerate the two heavy masses which are at a considerable distance from the centre, overcoming their strong inertia moment. The inertia moment of these masses is made sufficiently great, so that the disturbing forces have little effect; this feature makes it well adapted to handling heavy unbalanced valves.

The simplicity and reduction of friction have largely contributed to the success of this form. These features make it cheaper to construct, less liable to get out of order, more durable and more reliable in its action.

The ordinary double weight type may, by arranging it as shown, Fig. 7, employ the same inertia principle. Here, however, we have more joints, more friction, more complication and a more expensive type to build. With this combination it will be noticed that as the engine speeds up the balls shift and revolve in a larger circle; then they must be accelerated to this greater velocity, which is a more or less powerful factor in the governing, depending upon the general arrangement of the parts.

Usually we find the eccentric swung from a pivot on the same side of the shaft as the crank, and having positive lead throughout. In the inertia type, however, it is necessary to pivot on the opposite side to the crank in order to have inertia and centrifugal forces act together; this gives very slight and often negative lead for early cut-offs. The effect is to throttle the steam on admission, thus lowering the steam line to throw cut-off compression and release later. As to which method gives the best steam distribution is a question which is as yet fairly open to discussion.

A New Water Battery.

BY A. C. LONGDEN.

In some recent work with very high electrical resistances I have found it necessary to use rather high E. M. Fs.; and since the amount of current required was small a battery of high resistance was not objectionable. Nevertheless, some of the forms of water battery in use were not suitable on account of their enormous resistance. The form in which the zinc and copper pairs are mounted in a block of paraffin and suspended over a pan of water, into which they are dipped just before use, is convenient; but the resistance is exceedingly high, as high in some cases as 100,000 ohms per cell, before the last drop of water evaporates. Such a battery is very good for use with electrometers or condensers; but not for closed circuit work, even with all the other resistances in circuit very high.

A water battery in homœopathic vials, 3 dram size, with zinc and copper plates as large as will conveniently go into the vials, and with the water acidified with sulphuric acid to the extent of 1 gram in 100, has a resistance which is reasonably low for high resistance work. Such a battery is all that could be desired when it is first set up, but the zinc is soon in very bad condition and the E. M. F. falls considerably, even after the first few hours. It is for the purpose of describing a battery having this form, but from which the objectionable features have been eliminated, that this article is written.

In the battery which I have been using with great success for some months past the important new feature is the zinc plate, which consists of a thin film of zinc amalgam, spread over a copper plate which is used as a support. The plates are made in pairs by bending copper strips so that the two ends of a strip will dip into two adjacent vials. Then one end of each strip is amalgamated with mercury containing a little zinc. The plate should be amalgamated to within about a centimetre of the top, and the top of each pair of plates should be coated with paraffin or shellac, preferably shellac, to prevent mercury or salts from climbing. The zinc plate is about a centimetre longer than the copper and stands in a globule of zinc amalgam in the bottom of the cell. This globule of amalgam acts as a feeder to keep the surface of the plate continually bright and fresh.

The details of construction are shown in vertical section in the accompanying figure.

The vials used are preferably of the tube form, with straight sides, though the ordinary homœopathic vial with contracted neck will answer. Of course, for a given size the straight form will accommodate larger plates. This is a matter of importance if the battery is to be used on a closed circuit. For electrometer or condenser work the vials may be the smallest size obtainable and the plates may be made of copper wire.

The following data will enable the reader to judge what size the cell should be for any required work:

Size of Vial.	Depth of Water.	Width of Plates.	Approximate Resistance.
.7 × 3.5 cm.	2. cm.	No. 14 wire.	2000 ohms.
1. × 5. cm.	3.5 cm.	7 mm.	250 "
1.4 × 6. cm.	4.5 cm.	12 mm.	100 "
1.7 × 7. cm.	5.5 cm.	15 mm.	60 "

Of course the resistance may be varied by varying the strength of the solution. The above results are for a 1 per cent. acid solution. A stronger solution may be used without bad results, if the tops of the vials are coated with shellac to keep the salts from climbing. If the battery is to be used only on open circuit the strength of the solution may just as well be reduced to 1-100 of 1 per cent. and then there will be no trouble about climbing salts.

As the water evaporates from the cells it should be replaced with pure water, not with the acid solution originally used. Otherwise, the concentration of the solution will increase. It is not a very difficult matter to seal the cells and thus prevent evaporation entirely.

The E. M. F. of these cells is a little more than a volt. Usually about 1.08 if the cells are carefully set up.

In amalgamating the plates it is important to avoid getting any mercury on the end which is to be used as copper. Otherwise, the E. M. F. will be greatly reduced. It may be well to remark that

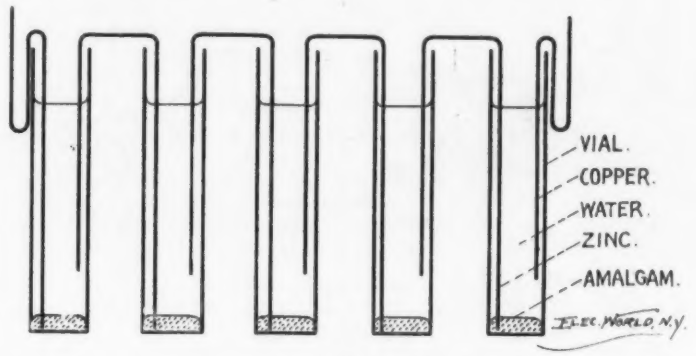


DIAGRAM OF WATER BATTERY.

although the end of the plate which is to be used as zinc must be perfectly clean before it is amalgamated, an ordinary layer of oxide on the copper end will do no harm whatever, and it will greatly reduce the probability of accidental amalgamation.

Of course, such cells as these will polarize rapidly if they are over-worked, but they also recuperate quite rapidly.

The chief value of this cell lies in the fact that in weak solutions the zinc arrangement is practically permanent. The E. M. F. never falls below its normal value unless polarization is allowed.

War and Cable Cutting.

It appears that the recent action of our naval forces in cutting cables at various places has caused a considerable excitement in England, where most of them are owned, and has also fomented a discussion as to the great advisability of laying or subsidizing cables between the British isles and the colonies in deep waters and by secret routes to guard against the possibility of the telegraphic isolation of England in case of war. It is said that the company owning the Hong-Kong-Manila cable, which was recently cut by Admiral Dewey and taken aboard one of his vessels in the harbor of Manila, upon applying to the British Government to have representations made to this country concerning an indemnity, was advised that its case lay against Spain, the captain general at Manila having forced the cutting of the cable by refusing the American officers the privilege of its use. Comment on the subject in English journals inclines to the view that the cutting of the cable was unwise, not only as establishing a bad precedent, but as well for the moral effect which a full report of the disaster at Manila would have had in Spain.

Motor Starters.

To the Editor of The Electrical World:

Sir:—I have read the communication of Mr. F. E. Herdman, which appeared in your issue of May 21, and which referred to an article previously published in The Electrical World, relative to the points which should be embodied in an ideal automatic motor starter.

Mr. Herdman claims to have constructed a starter over a year ago which fulfilled these requirements, and described the mechanism by which he accomplished this.

I give herewith a cut, showing an automatic starter made by me in 1891, under patents owned by the Automatic Switch Company, of this city, and which not only covered every point claimed by Mr. Herdman, but possessed the additional advantage of starting up automatically, should an interrupted current be re-established through the starter.

This type of starter has never been placed on the open market,

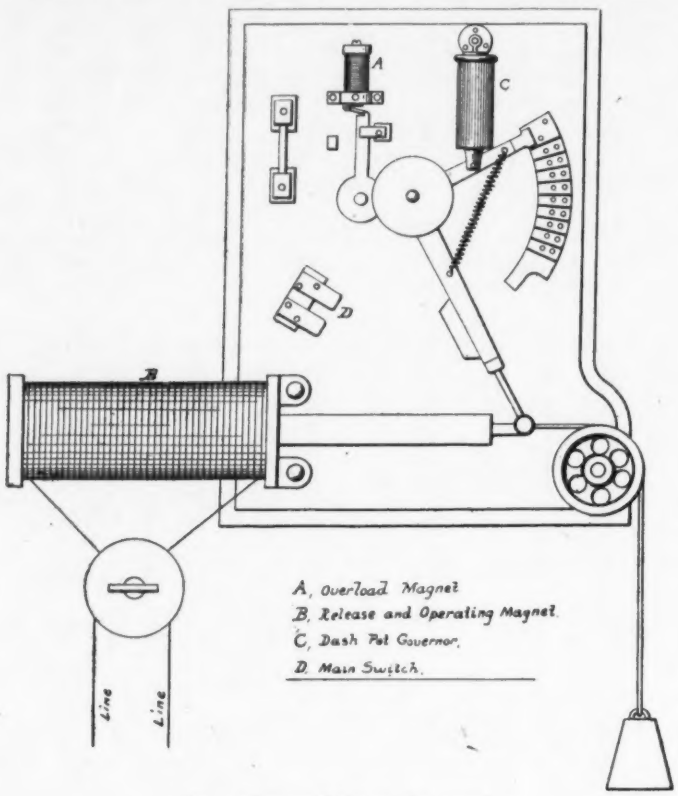


Diagram of Motor Starter.

but the original device was in satisfactory service in connection with an experimental push-button elevator.

Baltimore, Md. G. H. Whittingham.

[The starter shown in the illustration is evidently intended to operate as follows: On the application of the voltage across the high-resistance solenoid, *B*, a plunger is quickly pulled in, closing the single-pole main switch at *D*, and applying tension to the spring, which in turn moves the rheostat arm at a slow rate, governed by the dash pot, *C*. On the cessation of current supply the weight pulls the plunger out of the coil, *B*, opening the switch, *D*, and inserting again all the resistance. The overload magnet, *A*, appears to be merely a modified form of circuit breaker independent of the rest of the mechanism.—The Editor.]

The Controller Patent Decision.

To the Editor of The Electrical World:

Sir:—The sustaining of the Condict patent on the series-multiple controller by Judge Townsend was undoubtedly a just and proper decision, and will be a most valuable asset to the General Electric Company and the Electric Car Company. The status of this matter is perhaps not fully known, and as it might be interesting to others outside of the railway car builders I would make the following explanations:

The Hunter Electric Company, in 1887, made a number of these series-multiple controller switches under the broad inventions of myself, the first of which did not use the resistance outside of employing the sectional windings or fields for this purpose. These features are all covered in patents granted to me, the broad series-multiple controller patent being No. 385,055, June 26, 1888. Another broad patent is 494,705, April 4, 1893. This company was organized by me under my electric railway inventions, and Mr. Condict was employed as superintendent at our works. Owing to the large current used the contacts were more or less heated, with danger of fusing when the controller was moved slowly. To improve this Mr. Condict, in connection with my work, added the supplementary resistance to overcome this danger and at the same time increase the possible regulation. The improvement was undoubtedly an excellent one, and while specific, has proved to be universally approved, and is used with very little modification on all controllers. When the Hunter Electric Company later became known as the Electric Car Company of America this became the standard form of the Hunter series-multiple controller. The Thomson-Houston Electric Company purchased from the Electric Car Company of America the exclusive license to all of the patents and inventions which it controlled (amounting to very large numbers), and among which was the particular Condict patent upon which the court has recently rendered a decision. This patent being sustained, attention is called to the fact that practically all storage battery cars, electric carriages and cabs are infringing it, and are liable to the Electric Car Company of America. These manufacturers have appropriated the series-multiple controller as if it were public property, but in view of the recent decision they cannot avoid being treated as infringers. The decision, therefore, is far more reaching than at first supposed.

R. M. Hunter.

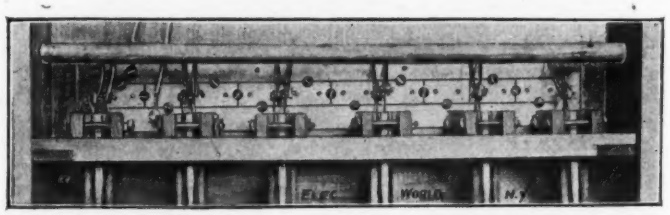
Philadelphia.

A Plug Switch for Connecting Batteries.

To the Editor of The Electrical World:

Sir:—Referring to the Digest reference to a "plug switch for connecting batteries," which appeared in The Electrical World of May 21, I do not see the advantage of connecting the two poles of cell No. 1 to the first and last blocks. If it were attempted to connect the battery in series by placing the plugs between the blocks and also between the end blocks and the side bars the battery would be short circuited. This difficulty can be overcome by connecting cell No. 1 to the first and second blocks, cell No. 2 to the third and fourth, and so on. It is evident that with this arrangement the first and last blocks must be always connected to the side bars, whatever the combination; so that these two blocks may be dispensed with, and one pole of the first cell and the opposite pole of the last may be attached directly to the side bars.

About three or four years ago I constructed a switch similar in principle to the one referred to, and send you under separate cover a photograph on which it can be seen. It is mounted on the back



View of Plug Switch.

edge of the frame of a 6-cell plunge battery. The heads of screws were used to make connections instead of plugs, but, of course, they are not so good for the purpose as the latter. It will be noticed that there are only ten blocks for the six cells.

Philadelphia, Pa. Andre J. Picolet.

An Electric Torpedo Boat.

To the Editor of the Electrical World:

Sir:—I have read with interest the article on an "Electric Torpedo Boat" in The Electrical World, and wish to suggest the use of the unipolar type of dynamo or motor in connection with a primary battery. So far as I can see the unipolar machine has many points which will recommend it for this class of service. Some of these are high efficiency at a low voltage; a high weight efficiency; no commutator; an exterior which may easily be made proof against shot and shell and so simple that a number of them

could be manufactured on very short notice. I have considerable faith in the electric submarine torpedo boat, and can readily imagine the Harvard or the Yale carrying a dozen of the little fellows across the Atlantic on her deck, launching them within 20 miles of a hostile fleet, and then picking them up after the mischief had been done.

We may also have a submarine dynamo cruiser, whose guns almost equal the length of the boat carrying them, whose water ballast and trimming tanks, and with them the elevation of the guns, are controlled by means of compressed air instead of ballast pumps.

Your editorial of April 23, 1898, may have a very desirable effect in that manufacturers will be ready to furnish a suitable primary battery, and also that correspondence on this subject will be stimulated.

Would it not be patriotic, especially at the present time, to turn over such letters to Uncle Sam if they are of practical value; and to publish those of little value as a stimulus to correspondents?

Our country, may she ever be right, but right or wrong, our country.

HERBERT I. WASHBURN.

SCHENECTADY, N. Y.

[Not having accepted the correspondent's suggestion, the publication of his letter does not imply that it is of little value.—THE EDITOR.]

An Historic Telegraph Instrument.

Mr. Hiram W. Sibley has presented to the Museum of Sibley College, Cornell University, the original recording telegraph receiver used by Professor Morse, Mr. Alfred Vail and Mr. Ezra Cornell, in the opening of the first telegraph line in this country between Washington and Baltimore, on May 29, 1844. The instrument was transferred to Mr. Sibley by Mr. Stephen Vail, of New York, son of Alfred Vail, for a small sum considering its actual historic value, with the understanding that it should be given to the college.

The Entertainment Features of the Chicago Convention.

The local reception committee of the National Electric Light Association has arranged the following programme for the entertainment of visiting members at the coming convention: Reception at the Auditorium Monday evening, June 6; excursion on Lake Michigan, Tuesday evening; lecture by Joseph Wetzler, Wednesday evening. Coaching trips through the parks and boulevards have been arranged for the ladies on Tuesday and Wednesday during the time of the meetings.

A Short Method for Determining Transformer Efficiency.

BY FREDERICK BEDELL.

That the common method for calculating transformer efficiency is laborious, and liable to error on account of long multiplications and divisions, has been pointed out by Mr. S. E. Johannesen, in THE ELECTRICAL WORLD, p. 388, May 14, 1898. He suggests a method which reduces somewhat the labor and liability to error; but his formula obtains the efficiency from the ratio of two quantities which differ from each other by only a few per cent., and consequently for accuracy each of these quantities must be very accurate and the long division carefully performed. Evidently, if instead of determining the per cent. efficiency direct we do so by determining the per cent. loss and subtracting from 100, the same degree of accuracy in the work will give greater accuracy in the result, and this may be done with less labor.

Let W represent the rated output in watts; let H denote the watts core loss and C the watts copper loss at full load. Let h_2 denote the core loss as per cent. of rated output W; that is $h_2 = 100\ H/W$. Let c_2 denote the full load copper loss as per cent. of rated output W; that is, $c_2 = 100\ C/W$. (The subscript 2 denotes that per cents. are referred to secondary output rather than to primary input.) Thus in a 2-kw transformer $W = 2000$. If the core loss is $H = 30$ watts the per cent. core loss is $h_2 = 1.5$. If the copper loss is $C = 48$ watts the per cent. copper loss is $c_2 = 2.4$.

Let g denote the fraction of full load, as ¾, ½, etc. Obviously the per cent. copper loss varies directly as g, being $g\ c_2$ at any load. Thus at one-half load the per cent. copper loss is ½ c_2. (In watts, the copper loss at half load is one-quarter copper loss at full load.) The core loss in watts being constant, the per cent. core loss is greater as the load is less, being h_2/g at any load. Accordingly at any load g the total loss (t) as per cent. of secondary output is

$$t = g\ c_2 + h_2/g.$$

The total loss as per cent. of primary input is $t - t_2/100$. This must be subtracted from 100 to give the efficiency. Hence

$$\text{Efficiency} = 100 + \frac{t^2}{100} - t.$$

To compute the efficiency accurately to four places, it is only necessary to compute t to three places and t^2 to two places. This may be quickly and accurately done by means of the following table:

EFFICIENCY COMPUTATION TABLE.

c_2 = ... = per cent. full load copper loss
h_2 = ... = per cent. core loss
} as per cent. of rated output.

Fraction of Load.	Losses as Per Cent. of Output.			$\frac{t^2}{100}$	Efficiency.
	Copper.	Core.	Total, t.		
1	c_2 = ...	h_2 = ...	....	....	....
¾	$\frac{9}{16} c_2$ = ...	$\frac{4}{3} h_2$ = ...	....	....	....
½	$\frac{1}{4} c_2$ = ...	$\frac{1}{2} h_2$ = ...	...	....	...
¼	$\frac{1}{16} c_2$ = ...	$2\ h_2$ = ...	....	....	....
⅛	$\frac{1}{64} c_2$ = ...	$4\ h_2$ = ...	....	...	....
1/10	$\frac{1}{100} c_2$ = ...	$10\ h_2$ = ...	....	....	....

$$\text{Efficiency} = 100 + \frac{t^2}{100} - t.$$

The all-day efficiency, if the transformer is x hours on full load each day and on no load the remainder of the time, is

$$\text{all day efficiency} = \frac{100}{100 + c_2 + (24 \div x)\ h_2}.$$

If the transformer is five hours on full load and nineteen hours on no load, the all-day efficiency is

$$\text{all day efficiency} = \frac{100}{100 + c_2 + 4.8\ h_2}.$$

The facility with which these computations can be made may be seen from the following example:

EXAMPLE.

2-kw transformer. Copper loss = 48 watts. Core loss = 30 watts.

EFFICIENCY COMPUTATION TABLE.

$c_2 = 2.4$ = per cent. full load copper loss
$h_2 = 1.5$ = per cent. core loss
} as per cent. of rated output.

Fraction of Load.	Losses as Per Cent. of Output.			$\frac{t^2}{100}$	Efficiency.
	Copper.	Core.	Total, t.		
1	c_2 = **3.0**	h_2 = **1.2**	**4.2**	**.18**	**95.98**
¾	$\frac{9}{16} c_2$ = **2.4**	$\frac{4}{3} h_2$ = **1.5**	**3.9**	**.15**	**96.25**
½	$\frac{1}{4} c_2$ = **1.8**	$\frac{1}{2} h_2$ = **2.0**	**3.8**	**.14**	**96.34**
¼	$\frac{1}{16} c_2$ = **1.2**	$2\ h_2$ = **3.0**	**4.2**	**.18**	**95.98**
⅛	$\frac{1}{64} c_2$ = **.6**	$4\ h_2$ = **6.**	**6.6**	**44**	**93.84**
1/10	$\frac{1}{100} c_2$ = **.24**	$10\ h_2$ = **15.**	**15.24**	**2 32**	**87.08**

$$\text{Efficiency} = 100 + \frac{t^2}{100} - t.$$

$$\text{All day efficiency} = \frac{100}{100 + c_2 + 4.8\ h_2} = \mathbf{91.24}.$$

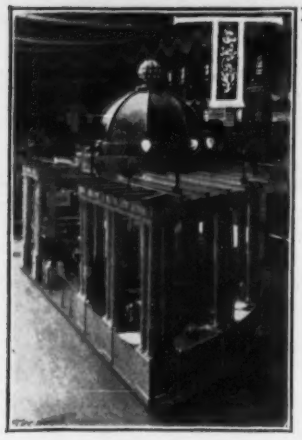
European Ideas of Geography.

One of the best French electrical journals, in giving some statistics concerning the tramways in New South Wales, explains in parentheses that that country is in the United States.

Liquid Hydrogen.

Professor Dewar has now succeeded in liquefying hydrogen, obtaining half a wine glass full in five minutes, the liquefaction being limited only by the supply of the gas. The boiling point of the liquid is about 30 to 35° C. of absolute temperature, or about 240° C. below zero. A test tube immersed in it was almost instantly filled with solid air. It may therefore now be produced in any quantity that may be required for investigation. He also succeeded in liquefying helium, whose boiling point is very nearly that of hydrogen.

At the Exhibition.



THE EDISON ELECTRIC ILLUMINATING COMPANY of New York City deserves no small amount of credit for the extensive and attractive exhibit it makes in the exhibition, the booth built by the Edison Company and shown in the accompanying illustration being the most elaborate and handsome architectural and decorative feature of the whole exhibition. Within this booth the Edison Company makes a practical exhibition of the varied uses of electric current intended to impress upon the untechnical visitor the advantage of a service connection with the Edison mains. Among these applications of current are the following: An ammonia refrigerating plant with a capacity of 3 tons of ice per hour, driven by a 5-hp C & C motor; a smaller machine of the same type, coupled to a Crocker-Wheeler motor; these two machines being supplied by the Hygienic Refrigerating Company; two printing presses driven respectively by General Electric and Crocker-Wheeler motors and printing special war news bulletins every evening; a wire stitching machine, driven by a small Lundell motor; a drill press, with a Crocker-Wheeler motor on the head of the spindle; a Quimby pump, coupled to a Lundell motor and controlled by a Zimdars & Hunt ball-float controller; Singer sewing machines, with Diehl motors in the hand wheels; an automatic piano, motor driven; MacIntire enclosed are lamps, ceiling and desk fans and incandescent lamps by the hundred. One part of the booth is occupied by the American Electric Heating Corporation, as described in another note.

THE STOW MANUFACTURING COMPANY, Binghamton, N. Y., is represented by a portable drilling outfit in the Edison Illuminating Company's exhibit. One of the Stow Company's ironclad portable motors drives a drill by means of a flexible shaft connection. Holes are drilled in a plate of cast iron 2 inches thick. The compactness of the motor and outfit is a very noticeable feature.

THE FARIES MANUFACTURING COMPANY, Decatur, Ill., has an exhibit of a special line of adjustable electric lamp holders and combined shade and shade holders. The adjustable holders are intended for shops, offices, dentists, surgeons, jewelers, residences and all places where it is desirable to adjust the lamp to different positions. The shades, which are of several different shapes, are made of aluminum or steel. No holder is required for them, as they are made to fit in the socket and may be instantly attached or detached.

Faries Manufacturing Company's Exhibit.

The shades and reflectors are made in three styles, the Parabola, or half shade, the cone shape and the ceiling shade. These are not only shades, but reflectors of the highest order. The company also makes boiler tube cleaners. This cleaner expands when pushed forward in the tubes, and collapses when pulled out, and, it is stated, never gets stuck in the tube. It is easily adjusted for variations in the sizes of the tubes, and has a ram which facilitates the operation of cleaning, especially when tight and uneven places in the tubes are encountered. The company has recently opened an Eastern office at 136 Liberty Street, New York City, and placed it in charge of Mr. A. W. Koenig.

THE HARRISON SAFETY BOILER WORKS, Philadelphia, Pa., has an exhibit in the basement of three Cochrane steam separators. One of them is the high pressure pattern for horizontal pipes, and the other two are for vertical pipes. The Cochrane special feed-water heater and receiver is also exhibited. The front of this apparatus is removed in order to enable one to

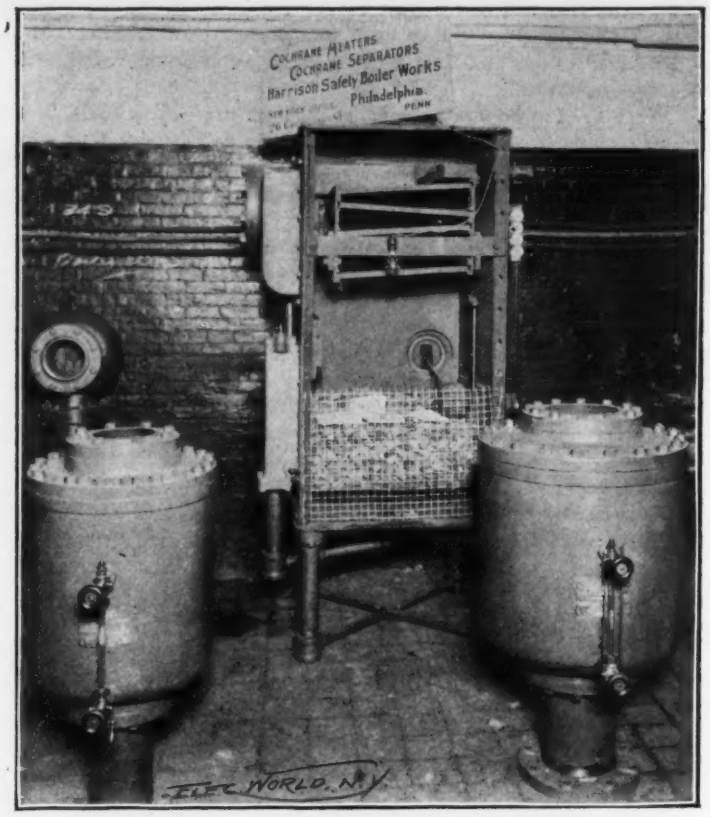
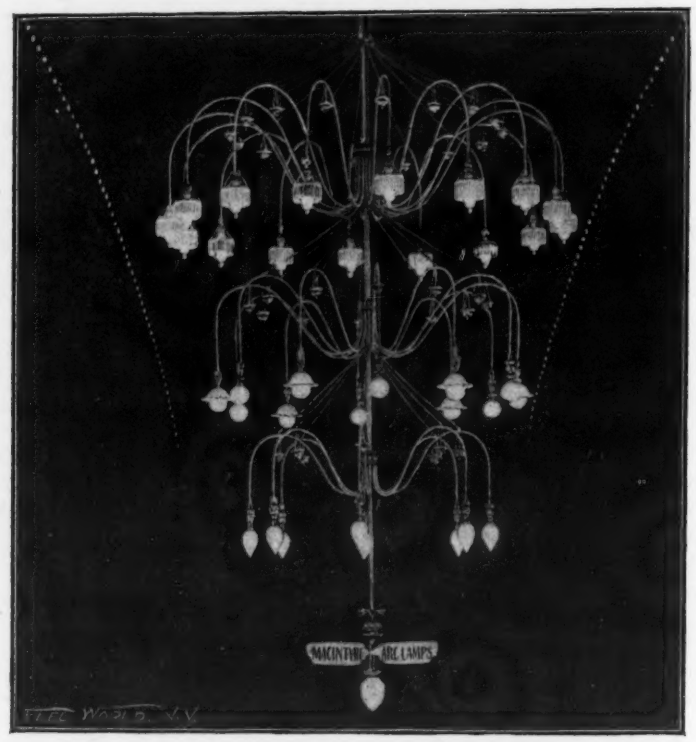


Exhibit of Cochrane Heater and Separators.

study the construction and action of the heater. These heaters are built for a working pressure of 15 pounds to the square inch.

THE INTERNATIONAL ARC LAMP COMPANY, New York, makes the most brilliant display in the whole exhibition in the great arcolier in the centre of the Garden. This carries in all thirty-seven arc lamps, arranged in three circular rows, the upper one with sixteen lamps and a sweep of about 16 feet; the next lower with twelve lamps and a smaller sweep; the next with eight



The MacIntire Arcolier.

lamps and a still smaller sweep, and a single lamp hung from the lower end of the central tube, with a Diehl ceiling fan revolving just above it. The name of the arc light company and of Mr. G. R. MacIntire, the designer, appears on the blades of the fan. All the lamps are enclosed arcs taking five amperes at 110 volts, the upper row being fitted with handsome prismatic decorations,

the middle lamps having outer ball globes, with shades over alternate lamps and the lower ones being fitted with the so-called stalactite outer globes. The construction of the arcolier itself is of no little interest. The whole thing with lamps attached weighs 1550 pounds. It is made up entirely of iron piping with a few special castings. Beginning at the top, it is supported by a block and tackle and a steel wire cable running to a windlass. The block is attached by an insulated joint to a heavy casting on the upper end of a 6-foot length of extra heavy 3-inch steam piping. The lower end of this is screwed into a heavy iron casting, shown in section in the accompanying illustration. From this casting radiate sixteen three-quarter inch iron pipes in graceful sweeping curves to the sixteen lights of the upper circle. The casting is not only threaded to the pipes entering it above and below for 3 inches of their length, but is pinned to each of them by four tapered pins driven through them. The three-quarter inch branch pipes run into the casting from below, pass through holes in which they clear, and are fitted with reducing caps screwed onto their upper ends. A heavy set screw holds each one in a proper radial position about the vertical centre tubes. From similar casting of a smaller size and fewer holes the pipes radiate to the two lower rings of lights. All the piping is finished with ivory white and enameled, and the radiating pipes are supported at the upper point of their sweep by bronzed chains attached to cast bronze sleeves, the central castings also being handsomely bronzed. Pendent from the points of attachment of the chains at the top of the sweep are decorative brass shells containing the series resistances of the arc lamps. The lamps are all run in multiple at 110 volts across the mains, and are grouped properly for supply from the Edison three-wire system. The mains are brought down through the central tube, each pair of mains, carrying four lamps, being wired to a separate switch in the roof trusses, so that any group of four can be cut out if necessary. The mains and branches are entirely run inside the piping, the mains in the central tube emerging just above the castings where the four lamps of each group are attached to them. This allowed the independent wiring of the central tube and the various branches at the works and their ready assemblage and final connecting up in position, the latter operations taking but four and a half hours. Beside this arcolier the International Arc Lamp Company has many other exhibits of its newel post and other lamps scattered through the exhibition, the total number of MacIntire lamps being some seventy-five. The regular lighting system of Madison Square Garden consists of 2200 16-cp incandescent lamps arranged under the roof arches and in twenty-eight rosettes of twelve lamps each. Two of these arches appear in the illustration, which is from a photograph of the arcolier taken by its own light. The incandescent lamps take some 1200 amperes, and give an illumination that is far from satisfactory. It is estimated that the great arcolier now in place, supplemented with two smaller arcoliers of sixteen lamps each, one at either end of the Garden and one enclosed arc lamp in place of each of the twenty-eight rosettes, would give a far more brilliant illumination, the whole number of arc lamps being about 100, with a current consumption of less than 500 amperes. It is expected that the management of the Garden will see fit to make this change.

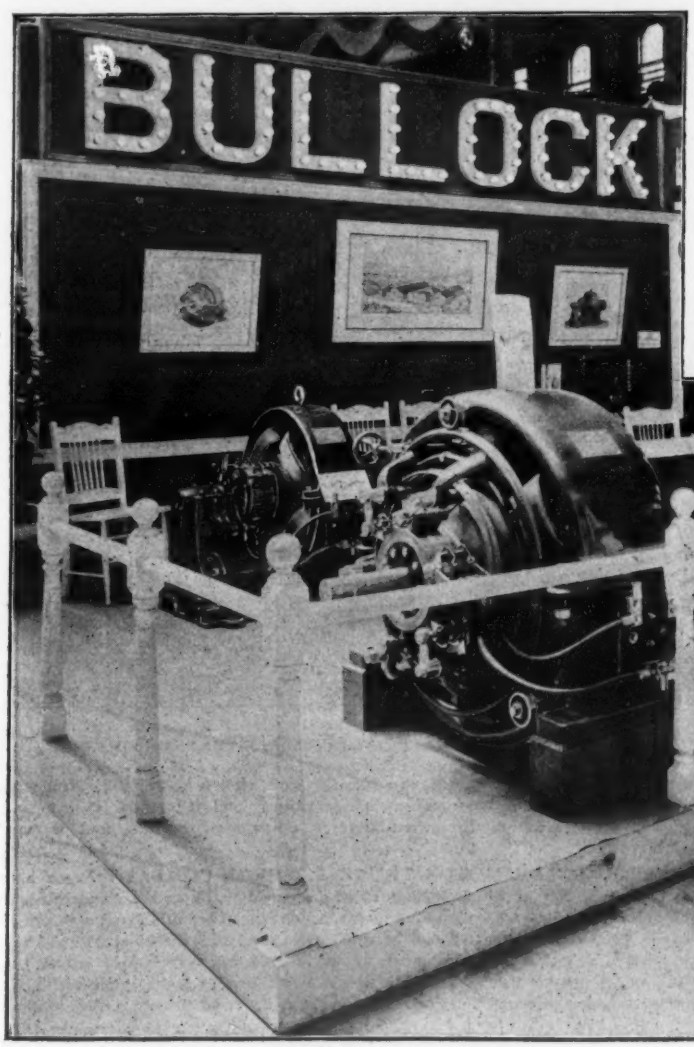
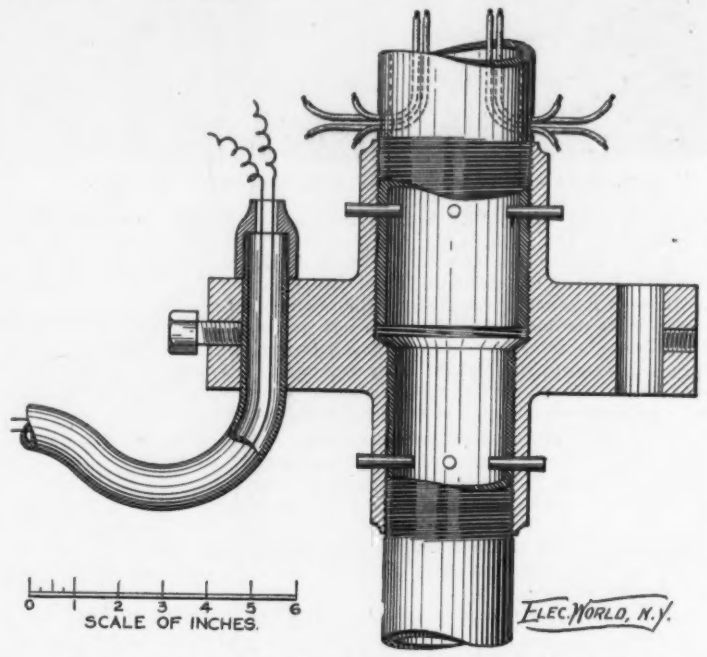


EXHIBIT OF THE BULLOCK ELECTRIC MANUFACTURING COMPANY.

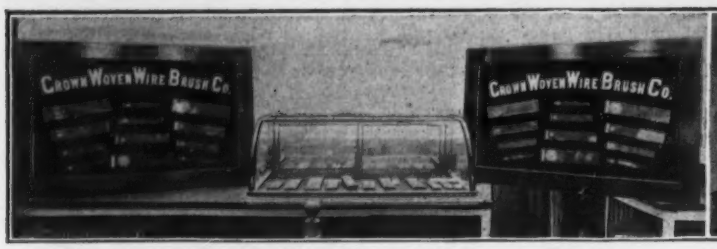
THE BULLOCK ELECTRIC MANUFACTURING COMPANY'S exhibit would be readily recognized without the sign by any electrical engineer from the distinctive brush rocker ring used on the Bullock machines. This ring is supported in three grooved wheels mounted on spindles projecting from the field yoke, thus giving easy manipulation, a considerable advantage in large machines. The largest generator in the Bullock booth at the exhibition is a six-pole, 25-kw 125-volt machine, designed for direct driving at 275 r. p. m.



DETAILS OF JUNCTION CASTING OF MACINTIRE ARCOLIER.

The other features included in this machine beside that mentioned are the arrangements of the field windings, the series coil being mounted on an independent bobbin near the pole with ventilating spaces between the series and shunt coils, the laminated poles cast into the iron yoke, the thinness of the armature discs being but .014 on an inch in thickness, and the method of fastening the machine formed coils in the parallel sided armatures lots without binding wires. Long wooden strips are driven in engaging in notches in the sides of the teeth. The machines are designed to carry 50 per cent. overload without sparking. A four-pole belt type of machine is also shown, as well as a 7½-hp motor. A completely enclosed machine represents a new type just brought out by the Bullock Company. In this the circular cap inclosing the armature end of the machine is packed with oakum and forced tightly into place, making the machine almost air tight. The Bullock motor controller with automatic releasing devices is shown, this being equipped with auxiliary circuits to the releasing device such that it can be released by push buttons or automatic appliances at any distance, a valuable feature in some work where the instant stopping of the machinery may be desired in emergencies. Mr. E. L. Reynolds is in charge of the exhibit.

THE CROWN WOVEN WIRE BRUSH COMPANY, Salem, Mass., has an exhibit of its brushes in the space of Messrs. H. B. Coho & Co., New York. In a showcase are displayed Crown "K" brushes, "Crown" brushes and alloy and phosphor bronze brushes, in different sizes of each. Samples of these different brushes are also shown in two frames hung on one of the columns in the booth. The Crown "K" brushes are made of woven, chemically pure, copper cloth. The cloth in the centre is made of braided wires woven together with a covering of fine cloth. This is shaped to the size under pressure, then sewed firmly together with incombustible thread. This style of weaving and making it is said gives great flexibility and ventilation to the brush. The sewing holds the brush firmly together and prevents it spreading at the ends. The "Crown" brushes are made of fine copper cloth of the ordinary weave, Nos. 50, 55 and 60 mesh cloth. They are made in three styles, viz., flexible endways, flexible sideways or stiff both ways. The company has recently added to its products several styles of flexible commutator connections.



The Crown Woven Wire Brush Company's Exhibit.

PHOTOGRAPHS illustrating the early work of Prof. S. H. Short are shown in the Short personal exhibit. Among them may be mentioned the following: The Short system in Rochester, N. Y., 1890; a car equipped with Short gearless motors, St. Louis, 1891; the Short experimental car, Cleveland, Ohio, 1889; the Short system, Dayton, Ohio, 1890; Professor Short's private car at the Buffalo Convention of the American Street Railway Association in 1890; the Short overhead trolley system in Huntington, W. Va., 1888, and many others of equal interest.

THE CLEVELAND TWIST DRILL COMPANY, Cleveland, Ohio, has a display, in a handsome oak show case, of samples of drills, reamers, electricians' bits. The drills with oil tubes make an interesting feature of the exhibit, as well as the large 3-inch drill, which is placed in a prominent position in the showcase. The New York office of this company is at 99 Reade Street.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., has quite an extensive and tastefully arranged exhibit of porcelain insulation of all kinds. A line of new fuse plug main and branch blocks is shown; also multiple circuit tablet boards with fuse plug, for both the two and three wire systems. The plug carries a continuous fuse placed in a ventilated chamber, which is readily accessible by unscrewing the cap. The all-porcelain transformer fuse plug is also shown as a new device. The plug is ventilated for the escape of gas and carries an extra long fuse. It is easily inserted in the box and gives a perfect contact. There is also shown a large line of covered porcelain mains, Peru style. These mains are made of extra heavy brass parts and extra long fuses. The principal part of the exhibit is shown on a four-sided frame fitted with sample boards. Porcelain bushings of all sizes are also shown. The exhibit also includes open porcelain and covered porcelain branch blocks of different sizes and styles, open and covered porcelain mains, two and three wire multiple circuit blocks, key and keyless wall sockets, branch and main circuits, fixture cut-outs, attachment plugs, the Peru 500-volt fuse plug, Peru rosette cut-outs, a full line of insulators and break knobs, cleats, etc. Also a full line of Hercules and Laclede batteries and many porcelain specialties. At two corners of the booth are standards bristling with high potential insulators. These insulators are made in one solid piece of porcelain. The exhibit is in charge of Mr. R. H. Bouslog, secretary and treasurer of the company. Mr. F. H. Schlesinger, the New York representative, is also in attendance.

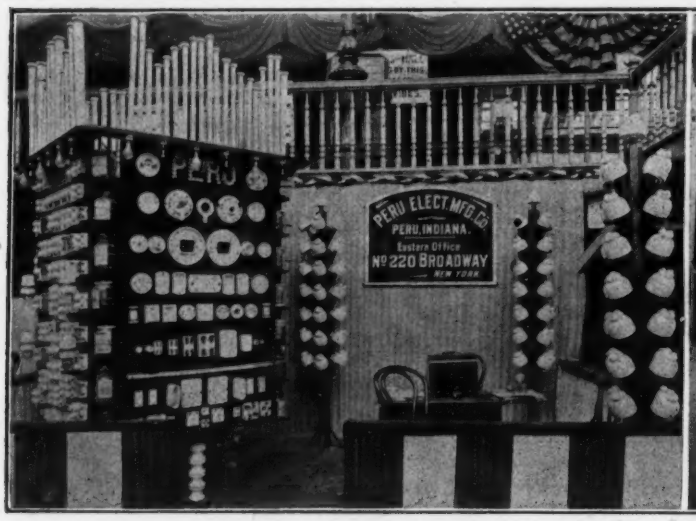
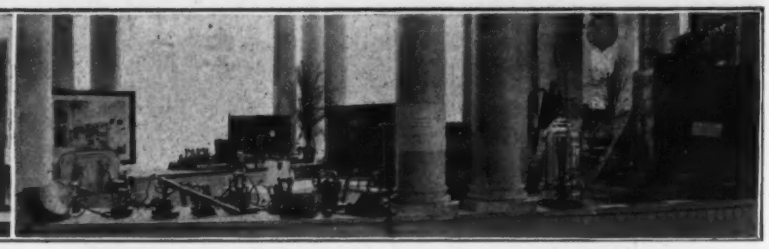


Exhibit of the Peru Electric Manufacturing Company.

THE AMERICAN ELECTRIC HEATING CORPORATION, Boston, Mass., is represented by an exhibit that appeals to the masses—especially to the housewife—probably more than any other in the Garden. The company, however, does not display its apparatus under its own name, the exhibit being a part of that of the Edison Electric Illuminating Company of New York. Every afternoon and evening crowds of interested visitors watch the cleanly work of cooking, ironing, etc., by electric heat. The apparatus to be seen in actual operation consists of about everything the American Electric Heating Corporation manufactures. Different sizes of portable stoves are shown. Their form is such that they can be used for heating anything that can be placed on a flat, hot surface. They become hot in about two minutes after the current is turned on. They vary in size from 4½ to 12 inches in diameter. The electric chafing dish is heated by a removable heating coil placed in the bottom of the dish. It boils water in five minutes, and costs about 8 cents per hour to operate. This, it is stated, is cheaper than alcohol. The farina kettles and coffee pots are heated by removable coils. These coils consist of copper nickeled tubes wound spirally to a diameter to easily slip into the vessel. The two conducting wires are run through the tube, the lower end of which is hermetically sealed. The wires emerge from the tube at the upper end, which is open, and are connected to an incandescent circuit by means of a flexible cord and connecting plug. These heaters are made for 52 or 110 volts, alternating or direct current, and of any desired capacity. The advantage of this form of heating coil is that it gives the maximum amount of heating surface, although it is not quite so easy to keep clean as the disc form of heater. A five o'clock tea standard on an electric stove constitutes another attractive feature. It heats quickly, and the heat is readily controlled. Bicycle tire vulcanizers, both for inflated tires and deflater tires, are also shown. The vulcanizer for inflated tires consists essentially of a sleeve split into two halves horizontally and hinged together at one side. After the tire is placed in position the two halves of the split tube are closed and clamped together, thus forming a sleeve around the tire. The interests and convenience of hair dressers are provided for by curling iron heaters, and ladies who do their own curling are particularly attracted by the smaller curling irons shown. These devices are used on an ordinary lamp circuit, and are provided with attaching sockets. Among the other utensils exhibited in actual operation are an electric cigar lighter, in which the current raises to a white heat an asbestos disc placed at the lighting end; a heating pad, which can be attached to any lamp socket; an electric foot warmer, soldering irons, which are made in three sizes and guaranteed for one year; an electric broiler, soldering pots, coffee urns, hot water urns, griddles; laundry, seaming, tailors' and flat iron, etc. The soldering pots can be heated at three different degrees of temperature. In using the large tailor irons the mere act of grasping the handle turns on the current. The electric oven can be heated to any one of three degrees, and the top or bottom can be made extra hot at will. In size the oven shown has outside dimensions of 15x18x21 inches. The exterior is sheet iron, and it stands on iron legs. There are beside the articles enumerated electric air heaters, foot warmers, glue pots, etc.



The American Electric Heating Corporation's Exhibit.

Exhibit of the Weston Electrical Instrument Company.

THE PECKHAM MOTOR TRUCK & WHEEL COMPANY has a booth at the exhibition in which it shows one full-sized truck and various miniature models of its most novel and elaborate designs. The full-sized exhibit is a swivel truck with a short wheel base of only 4 feet, the motor or motors being overhung at either end of the truck. It is built up with bridge trussed side frames, as are all the trucks shown in the exhibit. Of the models the most interesting is the centre bearing, triple cushioned, swing bolster swivel truck, designed for smooth riding at very high speeds. This truck has bridge trussed side frames supported on journal box springs, the spring plank being hung from the transom by swiveling links, and the bolster being supported on the spring plank by one-half elliptic and two helical springs, giving yielding side bearings. This makes the truck practically a centre bearing truck, by which all strain on the car body is removed, and yet eliminates the rocking motion. The links supporting the spring plank are hung on heavy rubber cuchions

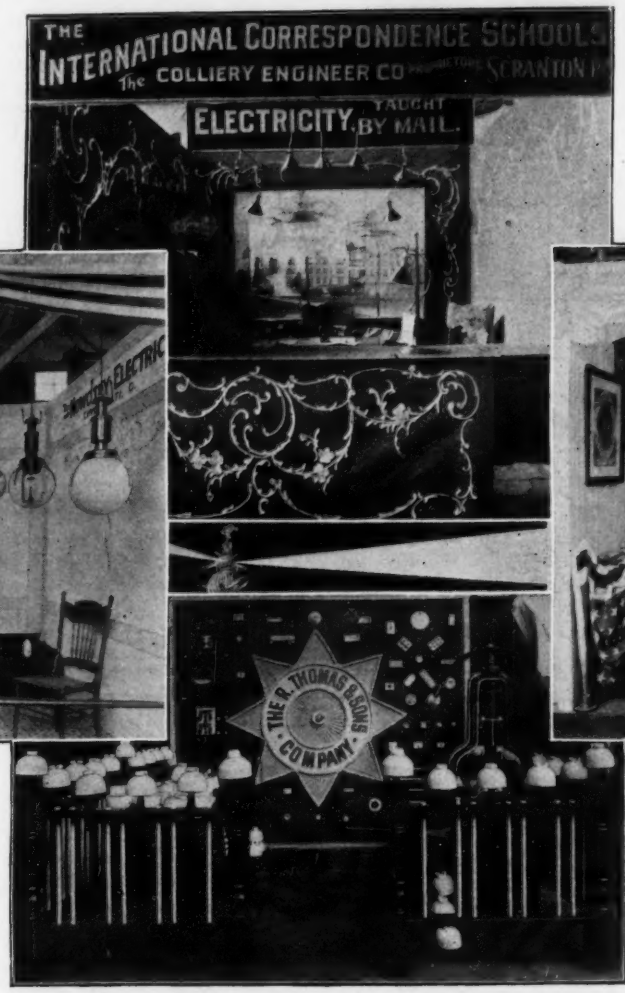
which are housed in within the transom, giving, with the two sets of springs mentioned above, the triple cushion effect. This truck, although the transom is at the middle of the wheel base, can be fitted for maximum traction in case one motor is used, by means of a half-elliptic spring on one end of the frame, bearing up through a roller against the under side of the car body. Another model shows the stationary bolster swivel truck with half-elliptic springs on the side frames and journal box springs, and another the centre bearing swing bolster maximum traction truck with overhung motors. Still another model shows the long cantilever truck for single truck cars.

MESSRS. MACHADO & ROLLER, 203 Broadway, New York, occupy a space on the main floor and have a display of the various articles for which they are agents. On a board suspended at the back of the booth are shown samples of "Perfection" dynamo brushes made by the Ohio Electric Specialty Manufacturing Company, Troy, Ohio. These brushes are said to be noiseless, sparkless, non-heating and flexible. The centre is of very soft composition wire gauze, especially prepared and annealed, and woven so as to give the brush the best of ventilation. Evenly distributed throughout the centre is a supply of graphite entirely sufficient to lubricate the commutator till the brush is entirely worn out. To give flexibility to the brush a few strips of the finest quality of leaf copper are added in its construction. The whole is then covered with pure copper gauze fastened in such a manner as to make it altogether impossible for the brush to spread out on the commutator end. These brushes are made in lengths from 3 to 12 inches, varying in width from three-eighths to 2½ inches, and in thickness from one-eighth to one-half inch. In a showcase is shown a line of Whitney alternating current voltmeters, potential indicators for continuous current, continuous current voltmeters—all for switchboard work. In another showcase are displayed samples of Whitney portable voltmeters, ammeters and wattmeters for direct and alternating current; also a portable testing set, which is very compactly and neatly designed and constructed. This latter instrument is said to be accurate within one-fifth of 1 per cent. at a temperature of 70 degrees Fahr. It is adjusted to the Board of Trade unit. The containing box measures 8x5x5½ inches, and the outfit completely weighs exactly 5 pounds. It has a range from 0.1 to 211,000 ohms. The connecting plugs are made entirely of brass, no hard rubber being used. On one side of the booth are two gas pipe standards supporting A. E. G. reflecting incandescent lamps. These lamps have spherical globes, the upper half of which is silvered. The silvered reflecting surface greatly augments the brilliancy of the light by throwing it all downward where it is most desired. The A. E. G. lamps are of all sizes and with different bases are displayed in one of the showcases, together with some samples of the reflecting lamp just referred to.

THE MONARCH MANUFACTURING COMPANY, 39 Cortlandt Street, New York, makes an exhibit in the basement of its engine stops and speed limits. An engine stop is mounted on a table in connection with an engine throttle valve, and the practical operation of the device is shown. In practice the stop is connected so that by pressing any one of several buttons placed at convenient points throughout the building, the engine throttle valve may be closed inside of five seconds. In order to make the demonstration plain to visitors, a church organ pipe is mounted on top of the valve, and below, the valve is connected with piping to a Sturtevant blower, operated by a Crocker-Wheeler electric motor. When the fan is running and the engine stop valve is open, a note is sounded from the organ pipe, but the moment the valve is closed the sound ceases. The speed limit is operated direct from a second Crocker-Wheeler motor, the speed being controlled by a rheostat. The new vertical engine in the New York Safety Steam Power Company's exhibit is equipped with a speed limit and engine stop. Mr. E. G. Fennelly, manager of the New York office, is in charge of the Monarch Company's exhibit.

THE WILLIAM S. HAINES COMPANY, Philadelphia, occupies a space in the basement, and has a display of Heintz steam traps of various sizes. On a table are placed six brass traps in sizes varying from No. 1, the smallest, to No. 6, the largest of the lot. Brass traps are used in the United States Navy. The company shows two radiators, one with its radiator trap connected and the other minus the trap, with thermometers attached to the radiators to show the higher temperature which can be derived by the attachment of the device. Other traps are connected on the steam line, with the outlet exposed, to show that it is possible for these traps to discharge all of the water contained in the steam line and not one particle of steam. These traps are used in connection with the steam supply pipe of different engines used in the various exhibits. Mr. A. W. McDougall is the New York Manager of this company, and Mr. Charles D. Riggins is in charge of the exhibit.

EXHIBIT OF NOWOTNY ENCLOSED ARC LAMPS.


THE INTERNATIONAL CORRESPONDENCE SCHOOLS
The COLLIERY ENGINEER CO
SCRANTON P
ELECTRICITY TAUGHT BY MAIL.
THE R. THOMAS & SONS COMPANY

THE INTERNATIONAL CORRESPONDENCE SCHOOLS' BOOTH.
EXHIBIT OF THE R. THOMAS & SONS COMPANY.

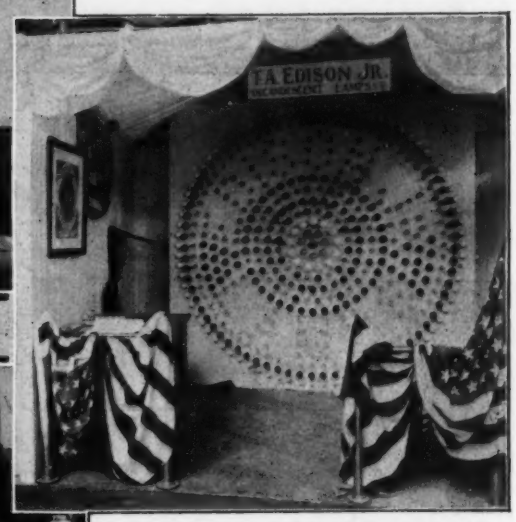


EXHIBIT OF T. A. EDISON, JR.

THE VACUUM OIL COMPANY, Rochester, N. Y., occupies a corner booth in the basement. A handsome showcase contains samples of all grades of oil made by this company, for street railway and electric light plants and all other classes of machinery. The oil of this company is in extensive actual use in the various operating exhibits at the show. Samples of greases in wide-mouthed glass jars are also displayed. Mr. E. A. Record, manager of the electrical department of the Vacuum Oil Company, is in attendance at the exhibit. Some interesting literature on the subject of oils, their uses, etc., is distributed.

THE BORNE-SCRYMSER COMPANY, 80-81 South Street, New York, exhibits a line of samples of its various grades and qualities of lubricating oils for every class of machinery, including electric, milling, marine, etc. Supported on a gas pipe standard at the back of the booth is a barrel, on the centre of which is the word "oils" wrought in small red incandescent lamps, and two rows of frosted lamps surround each end of the barrel. Many of the working exhibits at the Garden are supplied with oil by this company. The company does a large business with electrical generating concerns, and makes a specialty of supplying oils for their varied requirements. Its interests at the exhibition are looked after by representatives from the head office.

THE WALKER COMPANY is distributing an attractive pamphlet at the Garden, illustrating and briefly describing some of the isolated lighting plants installed by the company in various places throughout the country. The illustrations are made from photographs of the actual installations.

THE RIKER ELECTRIC MOTOR COMPANY exhibits beside its standard carriage, which has been described heretofore, a new delivery wagon built for B. Altman & Co. This vehicle weighs 2900 pounds, is fitted with one Riker bi-polar motor mounted after the so-called wheelbarrow fashion of street car

Exhibit of the Keystone Electrical Instrument Company.

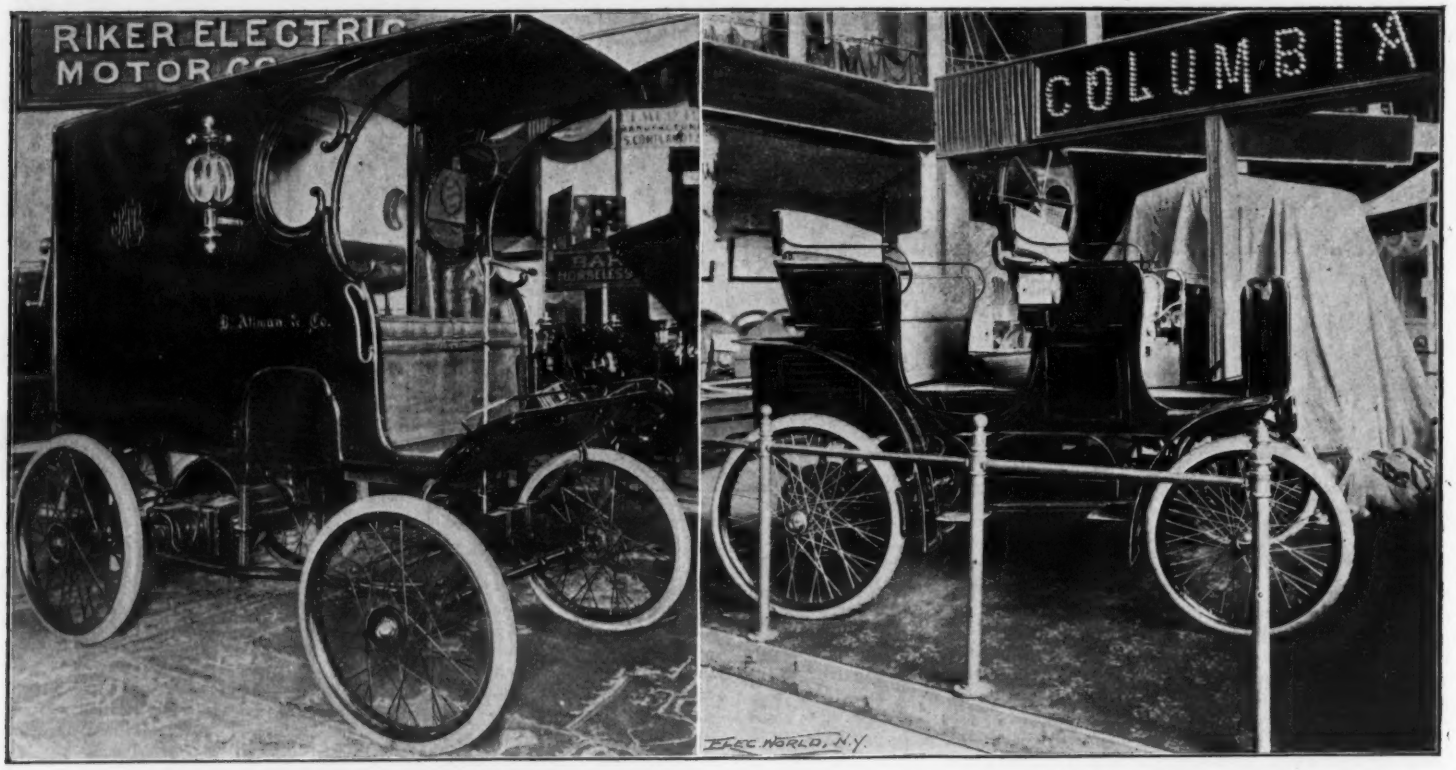
motors, with single reduction spur gears and a spring support at the forward end. Inside the gear case, mounted on the main shaft, is a pulley 14 inches in diameter, and with a 4-inch face on which runs a band brake, giving sufficient grip for any emergency. The "Jack-in-the-box" for allowing differential motion of the two rear wheels in turning corners is removed from the middle of the vehicle and placed within the hubs of the two wheels, thus giving a solid shaft across from hub to hub. The frame is made of steel tubes with malleable cast steel joints, and is rendered remarkably flexible by loose sleeves on the rear axle. The steering gear places the pivots within the hubs of the front wheels directly over the point of contact with the roadway, and the gear is so arranged that all four wheels remain tangent to concentric circles in turning. Ball bearings are used in all the hubs. On the footboard of the delivery wagon, as on the dashboards of the passenger vehicles, is a combination volt and ammeter, the latter instrument being centre reading for charging and discharging. The Willard storage battery, manufactured by Sipe & Sigler, of Cleveland, Ohio, is used.

THE CABINET MANUFACTURING COMPANY, Steubenville, Ohio, has a display of samples of telephone wood work supplies, consisting of battery boxes, transmitter boxes and boxes for complete wall sets. The boxes are made of oak, walnut and ash, and are well finished. The company's business was formerly in Ashtabula, but it was recently moved to Steubenville, where hard woods are abundant and nearby. Mr. J. J. Bayard, the New York representative, is looking after the company's interests at the exhibition.

THE NEW YORK CAR WHEEL WORKS, Buffalo, N. Y., has a booth on the main floor, in which are displayed some samples of machined car wheels fitted to axles and separate. These wheels are for motor and cable service. There are two pairs of 33-inch wheels and a pair of 30-inch wheels, fittd to axles. Samples of spoke and solid web wheels of various sizes are also displayed about the booth. On a table are exhibited fragments of wheel treads for the purpose of showing the depth of chill.

MR. J. H. WILDAY, 23 Duane Street, New York, has one of the popular exhibits in the Garden. It consists of an electrically operated engraving tool for engraving on metal. The engraver consists essentially of a solenoid in combination with a diminutive electric motor, the plunger of the solenoid giving a rapid reciprocal motion to the graver and the motor giving it a high speed rotary motion. The graver, therefore, cut in two directions. These machines are made by Mr. Wilday, and sold complete with a battery. He uses two cells of Chloride accumulator for the operation of each machine, which requires a pressure of four volts. The engraver can, however, be designed to run on any direct current circuit in connection with a rheostat. The apparatus shown at the exhibition is operated in this manner. Mr. Wilday shows the practical application of the device by engraving names, etc., on fancy metal articles which he has displayed for sale at the booth.

THE POPE MANUFACTURING COMPANY shows a new two-seated surrey with all the latest improvements in electric vehicle construction worked out by the company's engineers. The vehicle weighs 3000 pounds, and is fitted with two 2-hp Eddy bipolar motors. These drive the rear wheels through single reduction spur gears, the two wheels being independently geared to their respective motors, the armatures of which are always connected in series, thus doing away with any necessity for any differential gear or "Jack-in-the-box" arrangement. The motors are rigidly mounted on the steel tube framwork. The peculiar feature of the latter is the fact that it is virtually a tricycle frame, the forward truck—if the term may be excused—being pivoted on a horizontal fore-and-aft pivot at the place where the fifth wheel of an ordinary vehicle is situated, in such a way that the forward wheels can adjust themselves to any irregularity of the surface without straining the frame. The steering gear is of the hub pivot type, now almost universally used for motor vehicles. The motors are supplied with current by forty-two accumulators, with a capacity of 120 ampere hours at a 40 ampere rate of discharge. The controller gives four speeds, backward and forward, by varying the arrangement of the batteries, no dead resistances being used. The accumulators are placed under the two seats in the body of the vehicle. On the dashboard is a combined voltmeter and ammeter, the latter being a centre zero instrument, and within sight of the driver is an integrating wattmeter, with a dial which indicates the charge left in the batteries at any time. The armature shafts of the two motors are fitted with band brakes applied by a foot lever and an emergency hand brake on the rear wheels is also provided. The vehicle is fitted with electric side and headlights. The company also shows its standard single seated vehicle.



Riker Electric Motor Company's Exhibit.

Exhibit of the Pope Manufacturing Company.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering

Dynamos, Motors and Transformers.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," May 13.—The continuation of their long serial (see "Digest," April 23). They discuss the thermal limit of the output, giving practical data. For surfaces which do not move, such as those of the magnets, the increase of temperature may be taken to be about 80° C. per watt per square inch; for cylindrical surfaces of the same nature, but rotated with a peripheral speed of about 3000 feet per second, it is between 30 and 40° C.; the increase of temperature per watt per square inch increases as the surface speed is diminished; for smooth cored armatures the increase is about 25 per cent. greater at 2000 than 3000 feet; for ventilated armatures the increase is between 15 and 20° for 3000 feet, and between 10 and 12° for 6500 feet; this increase varies somewhat with the temperature of the surface, but is fairly constant for those used in practice. In transformers submerged in oil in iron cases the rise is about 35° per 0.1 watt per square inch of surface of the iron case at the end of ten hours; for those of 25 kilowatts and larger the increase may continue for a still longer period; the same transformers without oil will have 30 per cent. greater rise. These figures should be used with discretion, as the rise of temperature is modified greatly by various circumstances which they mention, such as the depth of the winding, the accessibility of air, etc. The length of the heat run should take into account the use to which the apparatus is to be put; heating is a positive advantage if limited to temperatures which keep the insulation dry. For magnets the surface is usually taken as the cylindrical surface, the ends not being considered, but for short magnets they should be considered if large; for armatures the surface is usually taken as that in which the heat is generated. An example is worked out. The internal and surface temperature is discussed and the results of some tests are given, showing the different temperatures of a magnet coil at different depths of winding, the temperature being measured by the resistances of the various layers. They show that without the circulation of air by the armature the metal of the field magnet coil is as effective in carrying away the heat as is the air which bathes the surface of the spool; also that the circulation of the air caused by the armature maintains the outside of the coil much cooler than the inner surface adjoining the coil; also that the interior layers may considerably exceed the temperature corresponding to the average rise of the resistance of the total winding.

TRANSFORMER SWITCHES.—"West. Elec.," May 21.—A translation, with the illustration, of the article noticed in the "Digest," November 20 (see also February 5 and March 19).

Lights and Lighting.

RARE EARTHS IN FILAMENTS. Lamotte. "L'Eclairage Elec.," May 14.—A short abstract of a French Physical Society paper, read April 1, in which he described the theory of Bunte. It has often been claimed that incandescent electric lamp filaments would be brighter if the carbon contained the materials used in Welsbach mantles. Bunte explains the action in these mantles, and if his theory is correct nothing would be gained in using these materials in filaments of electric lamps. According to his theory the light giving power of these mantles is not due, as is generally supposed, to a special emissive power of the material in them, but only to the combination of circumstances which enables a very high temperature to be reached; this is due in part to the catalytic properties of the oxide of cerium and partly to the extreme subdivision of it; the oxide of cerium lowers the temperature of combustion of a mixture of hydrogen and oxygen from 650 to 350° C.; the combination is therefore very active in the immediate surrounding of the mantle and a large quantity of heat is disengaged; owing to the bad conductivity of the fine threads the heat inside, not being dissipated rapidly, is concentrated and the temperature is therefore very high.

INCANDESCENT LAMP INDUSTRY.—Lond. "Lightning," May 12.—A short article on the contemplated improvements in the filaments. Several early patents are cited, showing that the mixing of metallic salts and oxides with the filament to increase the resistance and the light is not new; Lane Fox, for instance, in his patent of 1878 stated that coating the surface of filaments with certain materials seems to make them give off more luminous radiations in proportion to the dark radiations. It is concluded that the only novelty remaining, therefore, lies in the details of the method of carrying the general principles into effect. An English electrician named Jackson has been experimenting in this direction, and concluded that the practice of treating the filament must be abandoned in order to get lamps of high efficiencies by running them to a higher temperature, as treated filaments will blacken the bulbs at these temperatures; he mixed certain percentages of alumina with the carbon, which increased the specific resistance and enabled him to use stronger filaments, with a considerable saving of power; for the same weights the lamps will last longer or for the same life they will be more efficient; no further data regarding this lamp are given.

CARBONIZATION OF FILAMENTS BY ELECTRICITY. Powell. Lond. "Elec. Rev.," May 13.—An article in which he describes his experiences with that method of carbonizing which he tried some five years ago, but his experiments were only rough and superficial; he suggests that it be tried by those having better facilities. The celluloid filaments are packed in plumbago powder in a closed vessel, through which a current is made to pass until they are thoroughly baked; certain conditions must be observed. His first trial was a failure, due, probably, to the access of air during cooling; in the second trial this was effectually prevented and after heating about twenty-three hours the filaments were satisfactory in every respect. He suggests some materials and arrangements, and states the probable advantages of this method of carbonizing; the question of cost he believes will be in favor of electricity.

TEMPERATURE OF INCANDESCENT LAMPS. Janet. Lond. "Elec. Rev.," May 13.—A translation of the French Academy paper noticed in the "Digest," April 16 (the author's name seems to have been inadvertently omitted in this translation).

LIGHTHOUSE AT PENMARCH.—"Elec. Rev.," May 25.—An abstract, with an illustration, of the article noticed in the "Digest" last week.

ELECTRIC FOUNTAIN.—"Elec. Eng.," May 21.—An illustrated description of the one at the Omaha exhibition.

Power.

SIMPLON TUNNEL.—"L'Elettricita;" noticed briefly in the Lond. "Elec.," May 13.—A long article referring to the cheapening of tunnel boring by electricity. This will be the longest tunnel in the world, its length being 12.4 miles, and it will be bored by electrical power; the contractor agrees under penalty of $1000 per day to complete the tunnel four times as fast and at half the cost per mile, as compared with the Mont Cenis tunnel, built thirty years ago. Electric lighting will also take an important part in the work. It has been practically decided that the railroad through the tunnel will be operated electrically.

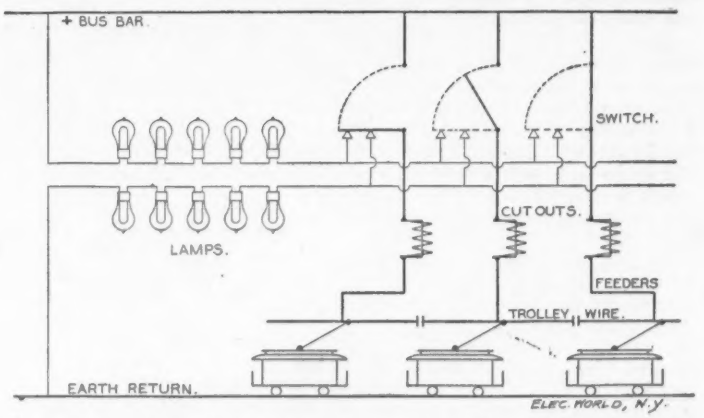
UTILIZATION OF BLAST FURNACE GASES. Twaite. Lond. "Elec. Eng.," May 13.—The beginning of a reprint of the long paper which was referred to in the "Digest" last week; it deals chiefly with the advantages to the iron trade.

UTILIZATION OF BLAST FURNACE GASES.—"Eng. & Min. Jour.," May 21.—A brief account of the extended trials made with a furnace in Belgium in which the energy is used to run an electric lighting plant, the gases being used in a gas engine. The difficulties expected, due to the variable composition of the gas, were found to be much less than were anticipated, and they were almost entirely overcome by using a higher degree of compression. The furnace in question uses charges of 2400 kg of ore and 1000 kg of coke to produce one metric ton of iron, and they yield an average of 4300 cb. m. per each ton of iron; a furnace making 100 tons of iron a day would therefore supply about 18,000 cb. m. of gas per hour; allowing 50 per cent for the blowing engines and a utilization of 20 per cent in the engine, a blast furnace of this size would supply about 3000 horse-power. The experimental engines averaged 5 cb. m. of gas per horse-power hour, at which rate 1800 horse-power would be available; the use of a gas engine would decrease the cost of the furnace plant, as the cost of boilers is much greater than that of the gas cleaning and storage plant. The utilization of the gases in this way is certainly of sufficient importance to deserve careful attention.

BELLEGARDE.—"West. Elec.," May 21.—A short, illustrated description of this water power plant in Switzerland.

Traction.

TESTING THE INSULATION OF RAILWAY CIRCUITS. Stobrawa. "Elek. Zeit.," May 12.—A short article describing an interesting method which has been used with success on an extended system of lines and by means of which the conditions of the insulation can be determined at any time very easily and quickly. He does not recommend the system of testing lines, after the circuit



breaker has opened, by repeatedly closing it again; the question is not to determine the exact insulation resistance, but to find quickly whether a short circuit still exists or not. The accompanying diagram shows the requirements; there are two series of five lamps each, connected as shown between the bus bar and the earth return, the series of all ten of them being closed by the switches shown, when a test of the particular feeder (three of which are shown) is to be made. When the insulation is perfect and one of the switches closed as shown, all ten of the lamps will burn evenly and dimly; if the feeder or its trolley section diminishes in insulation resistance, the upper row of the lamps will burn brighter than the lower, and in case of a complete short circuit the upper ones will be quite bright, while the lower ones will not burn at all; with a little experience the relative illuminations of the two series of lamps will give an approximate but very sure indication of the insulation of that section; the few lamps on the cars which may be in circuit will not interfere appreciably in this measurement; the same apparatus can be used for any number of feeders if the connections are properly extended along the switchboard. Working drawings of the additional switch are also shown.

SELF-CHARGING MOTOR CAR.—Lond. "Elec. Rev.," May 13.—A note stating that Epstein recently patented a new motor car in which the storage batteries are charged whenever required with an oil engine carried on the car; the extra weight is only 3 per cent.; the weight of the complete car "and four passengers" is less than 30 cwt., the accumulators weighting 7 cwt.; it is said to run a distance of 60 miles on ordinary roads; one of these is now in course of construction; no further data are given.

RAILWAY RETURNS.—Lond. "Elec. Rev.," May 13.—The conclusion of the reprint of Parshall's recent paper and a reprint of those by Trotter and by Cardew, all of which have been noticed in the "Digest."

Installations, Systems and Appliances.

DEFINITION OF THE LOAD FACTOR. Hammond. Lond. "Elec.," May 13.—A communication in which he urges that the definition of the term load factor should be settled once for all. In his recent paper he used the term in the sense that it is the ratio of the actual units generated during the year and the product of the maximum load of the year and the total hours of the year; others have argued that instead of maximum load it should be the maximum plant capacity; he claims that the latter definition would render the term quite useless as a means of comparing the respective advantages held by various works with regard to the continuance or otherwise of that load which influenced costs of working; he illustrates his objection with an example, using two similar stations, but with a different maximum plant capacity and maximum output; under the "generally accepted definition" (which is the one which he advocates) the load factor would be 12.68 per cent., while what he calls the spurious load factor would be 7.60 for one and 11.41 per cent. for the other, the two plants being exactly alike except that one had installed an additional capacity, but had not used it, while the other had also ordered it, but had not yet installed it; he thus reduces that definition to an absurdity. He acknowledges that a comparison of the output with the plant capacity is a valuable one, but it should be designated by some other word than the term load factor. He then discusses his suggested improvement for arriving at the proper percentage of use of the plant, repeating a portion of his recent paper, in which he gives the load factors based in one case on the "average" demand of the year and in the other on the "maximum" demand at the end of the year, which is greater than the average of that at the beginning and the end; the new load factor (based on the average maximum demand) is in each case somewhat higher than the one more generally in use, and forms a much more reliable guide. He suggests the use of the average daily maxima of the year instead of the maximum of the year, and by way of illustration works out an example of two stations whose load factor is precisely the same, in one of which the load has not been increased during the year, while in the other it has; under the old method the load factors would be 15.22 and 12.17 per cent., while by his proposed method they would be 16.11 and 16.15 per cent. Editorially it is claimed that the suggestion to use the maximum load rather than the plant capacity is itself a debatable point.

CONNECTING ALTERNATORS IN PARALLEL. Frisch. "Zeit. fuer Elek.," May 8.—An illustrated description of the method used by a Viennese company for bringing an alternator into synchronism with others; the method has been in use since 1893, has been satisfactory, and is now used in a number of central stations. To bring an alternator into synchronism by first connecting it to the mains through a resistance is not as simple as might at first appear; it is necessary at first to bring the alternator to approximately the correct speed, after which a slight amount of power will bring it into synchronism. The alternator to be connected is first switched on a pair of auxiliary bus wires, which are arranged so that any alternator can be connected with them; the ends of these are connected to the primary of a transformer, the secondary of which is connected in series with the thick winding of another identical transformer through an adjustable resistance, and the fine wire coil of the second transformer is connected to the mains; the resistance is then gradually cut out: the whole operation requires but three or four minutes. With alternators of 440 kilowatts the two transformers should have a capacity of about 10 kilowatts each. This method is not directly applicable to starting all the alternators in the case of a complete stoppage when the circuit is loaded, but this can be done by bringing the machines to their full speed, connecting them with the mains, but without exciting their field, and then starting and gradually increasing the exciting current; at about half the normal voltage they will be in complete synchronism; but it is necessary that all the engines have the same steam pressure and that the excitation is the same in all the alternators.

ELECTRICITY SUPPLY. Gibbings. Lond. "Elec.," May 13.—In this continuation of his serial (see "Digest," May 21,) he begins the discussion of the various methods of charging. A table is given of the average demand in hours and minutes per day by a large number of classes of consumers, the figures being the actual averages for the Bradford station; the table does not refer to the quantity of light, but merely to the time during which it is used per day; a similar table is given for motive power.

DISTRIBUTION OF ELECTRICAL ENERGY IN GERMANY. Laffargue. "Bul. Soc. Int. des Elec.," April.—The complete paper, an abstract of which was noticed in the "Digest" last week.

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," May 13.—An analysis of the accounts of the Worcester municipal, the St. Pancras and the Guildford stations.

PARIS. Reyval. "L'Eclairage Elec.," May 14.—A very long, profusely illustrated description of the new station at the Quai Jemmapes.

PARIS. Laffargue. "El'ty," May 25.—The beginning of a reprint of the article noticed in the "Digest," May 21.

Wires, Wiring and Conduits.

PREVENTING INTERRUPTIONS IN SUPPLY.—Lond. "Elec.," May 13.—A long abstract of the discussion of Andrews' paper (see "Digest," last week); the whole paper, with a brief abstract of the discussion, is published in the Lond. "Elec. Eng.," May 13; the discussion is abstracted briefly in the Lond. "Elec. Rev.," May 13.—Raworth agreed that it is futile to use direct fuses on the connecting links between the dynamos and the bus bars; he believed the first accident to one of the London companies was due to this cause, one fuse after the other blowing and completely extinguishing all the lights. He constructed a fuse for this purpose which was shunted with a small transformer so connected that it tended to increase the volts through the shunt, thus sucking the current through the shunt, but the moment the current went back to the machine it was diverted by this shunt through the fuse, which would then blow. Chattock thought Andrews' switch met the necessities of the case; referring to the interconnection of the sub-stations, he thought if a short circuit occurred on the intermediate connector the cut-out would not discriminate and both fuses would probably blow; this could be obviated by feeding each sub-station distinctly and not interconnecting them; the recognized system in alternating current work is to have the circuits coupled together on the main bus bar at the station, but not to interconnect them outside if it could possibly be avoided. Lawson thought that for some cases the cut-outs would be too sensitive; the system of interconnection he thought would be very expensive, although very reliable. Raphael thought the fire insurance officers would object to having fuses which blow at 300 per cent. overload; there are two kinds of leakage from a house circuit, one from wire to wire and the other to earth; the former could be dealt with by fuses, as the connection would either be a short circuit or nothing at all, but it was very seldom that leakage to earth reached 300 per cent. overload, and a few amperes leakage would be quite dangerous as a fire risk; these two kinds of leakage should therefore be dealt with separately, fuses being used to guard against the short circuiting currents, while the earth currents should be led through an automatic device, a form of which he describes and illustrates; it seems to be applicable only to cases where the wiring is contained in metallic tubes; the end of this tube is grounded through a fuse which holds back a switch, which, when released, connects the two main wires together through a resistance, and on the house side of the main fuses, thereby blowing them and disconnecting the whole circuit; there is no chance of this system being adopted. Bathurst believed that electric wiring ought to be done in armored insulating pipe, which would keep all the currents from the earth. Scott claimed that the Brush and the T.-H. machines seem to get along very well without such discriminating fuses. S. P. Thompson thought that such a device would be welcomed by those who had to parallel large machines; a machine should be so built that it would not come to pieces either by short circuiting or by being thrown into parallel with machines when it was not in phase; fuses should be avoided. Andrews, in his reply to the remarks of Chattock, stated that excess current cut-outs might be used at each end of the auxiliary feeder, each adjusted to operate at half the current required to blow the fuses; in replying to Lawson he said that the quicker the cut-outs operated the better; the apparatus described by Raphael would tend to increase rather than decrease the number of interruptions; he approved of Bathurst's suggestion.

CABLES WITH AIR CIRCULATION. Barbarat. Lond. "Elec.," May 13.—A translation in abstract of the paper noticed in the "Digest," April 9 and 30.

Electro-Physics and Magnetism.

NEW WAVE DETECTOR. Righi. "Nuovo Cimento," February; noticed briefly in the Lond. "Elec.," May 13.—When the electrodes of a tube containing air at a suitable pressure are subjected

to an E. M. F. not large enough to break down the layer of air, a discharge may be suddenly induced in certain cases by increasing the distance between the electrodes; under the same circumstances very slight causes like the approach of the hand suffice to bring about its illumination. He shows that a satisfactory wave detector may be constructed on this principle, and with the aid of a relay it may be made as sensitive as a coherer, with the advantage that it needs no tapping.

BEHAVIOR OF MATERIALS TOWARD OSCILLATIONS. Drude. "Zeit. f. Elektrochemie," May 5.—An abstract of a paper read before the German Electrochemical Society. When materials have conductivity it is difficult to determine their dielectric constants, and to overcome this recourse is had to the use of electric oscillations; he used waves of 75-cm wave length and obtained a dielectric constant of concentrated nitric acid, for instance, of about 32. Every substance has for a certain frequency two characteristic constants, the dielectric constant and the index of absorption, the latter showing at what rate the material absorbs the oscillations, transforming the energy into heat. An apparatus is briefly described for easily determining the absorption and the dielectric constant.

STRATIFIED DISCHARGE IN FREE AIR. Toepler. "Wied. Ann.," 63. page 109; abstracted, with a number of illustrations, in "L'Eclairage Elec.," May 7; a description of experiments.

PHOTOGRAPHIC ACTION OF METALLIC VAPORS. Russell. "Proc. Roy. Soc.," April; abstracted briefly in the Lond. "Elec.," May 13.—Muraoka and Kasuya found their supposed glow worm rays to be due to certain vapors; this same result has been obtained independently by Russell, who shows that the action is really due to the vapor and not to radiation.

LUMINESCENCE AND X-RAYS. Sagnac. "Rev. Gen. des Sc.," April 30.—An article in which he gives a summary of his researches on the transformation of X-rays by substances which absorb them, thereby transforming them into new rays which are closely related to X-rays and at the same time approach the characteristics of extreme ultra violet rays.

VISIBILITY OF X-RAYS. Courmelles. "L'Eclairage Elec.," April 30.—An abstract of an Academy paper in which he describes experiments made with young blind subjects. Out of 204 there were nine who could see the rays. It is not possible to draw definite conclusions from the observations.

THEORY OF RONTGEN RAYS.—Lond. "Elec. Rev.," May 13.—Stokes suggested a theory several years ago, according to which these rays are aperiodic electromagnetic waves caused by the impact against the anticathode of the charged particles in the cathode stream; this theory was recently developed by J. J. Thomson ("Phil. Mag.," page 172). Lord Rayleigh, in "Nature," April 28, protests against the acceptance of this theory, as it does not carry with it some of the consequences which have been deduced as the distinction between Röntgen rays and ordinary luminous and non-luminous radiation; he does not agree that Röntgen rays are not very short waves, but impulses; he favors the view that the waves differ from ordinary light only in the shortness of their waves.

CATHODE RAYS. Battelli and Garbasso. "Nuovo Cimento," Vol. 4, page 129, and Vol. 6, page 5; abstracted in "L'Eclairage Elec.," May 7.—A paper discussing the action of cathode rays on insulated conductors. The results agreed with the hypothesis that the difference between the action of cathode and Röntgen rays depends essentially on the conditions of the medium which surrounds the electrified conductor.

CATHODE RAYS. Ebert. "Wied. Ann.," 64, page 240; abstracted at some length in "L'Eclairage Elec.," May 7.—He describes the action of alternating electric fields on cathode rays.

CATHODE RAY SPECTRUM. Birkeland. Lond. "Elec.," May 13.—A translation of his recent French Academy paper.

CALCULATION OF ALTERNATING CURRENTS. Pellat. "L'Eclairage Elec.," May 7.—An article showing how imaginary quantities may be used to advantage in the calculation of alternating currents.

THERMO-ELECTRIC E. M. FS. OF CRYSTALLIZED BISMUTH. Perrot. "L'Eclairage Elec.," May 7.—A reprint of a short French Academy paper.

CONNECTION BETWEEN FARADAY AND ZEEMAN EFFECTS. FitzGerald. "Proc. Roy. Soc.," April 20; noticed briefly in Lond. "Elec.," May 13.—He shows how one effect could be calculated from the other.

FRENCH PHYSICAL SOCIETY EXHIBITION. Guisot. "L'Eclairage Elec.," May 7.—Brief, illustrated descriptions of quite a number of exhibits, including the Guyou apparatus for demonstration and practice in the compensation of the compass for vessels; also a new induction coil with a motor break over mercury, and an abstract of a paper by Ducretet on Hertzian telegraphy, describing his apparatus with the aid of illustrations.

PROPERTIES OF BECQUEREL RAYS. Stewart. "Phys. Rev.," April.—A summary of the present state of our knowledge on the subject, and its bearings on the subject of X-rays. He concludes that there can be no doubt that they are transverse ether rays; transmission by metals indicates that the wave lengths must be shorter than that of any ultra violet rays which have been obtained from any light source. Like X-rays, they are not homogeneous; the similarity between the two rays is very striking, the principal difference being the absence of any reflection or refraction of X-rays; this leads to the conclusion that X-rays are also transverse waves shorter than Becquerel rays; the similarity of both presents a strong argument in favor of the theory that X-rays are short, transverse ether waves.

SUSCEPTIBILITY OF DIAMAGNETIC AND WEAKLY MAGNETIC SUBSTANCES. Wills. "Phys. Rev.," April.—The complete paper which was noticed in the "Digest," last week.

Electro-Chemistry and Batteries.

PREPARATION OF GLUCINUM. Lebeau. "L'Eclairage Elec.," May 7; a brief abstract of an Academy paper from the "Comptes Rendus," p. 1223.—He describes a process which consists in heating a mixture of emerald (containing 5 per cent. of glucinum) and carbide of calcium in the electric furnace.

PREPARATION OF SILICON.—"L'Eclairage Elec.," May 7.—A note describing the experiments of Lebeau with the electric furnace, which shows the possibility of obtaining this material on a commercial scale.

ELECTRICAL BEHAVIOR OF CHROMIUM. Hittorf. "Zeit. f. Elektrochemie," May 5.—A reprint in full of a long paper, which appears to be about the same as the one of which an abstract was noticed in the "Digest," May 21.

ACCUMULATOR MAKING.—Lond. "Elec. Rev.," May 13.—An illustrated description of the method of making lithanode accumulators (in which the peroxide of lead is in the form of hard, stone-like masses).

LEAD-ZINC AND CADMIUM ACCUMULATOR.—"L'Eclairage Elec.," May 7.—A description of the Werner accumulator, referred to in the "Digest," May 21.

FRENCH DUTY ON ACCUMULATORS.—Lond. "Elec. Eng.," May 13.—The new duty amounts to about $33.50 per ton.

MEETING OF THE GERMAN ELECTRO-CHEMICAL SOCIETY.—"Zeit. f. Elektrochemie," May 5.—The beginning of a verbatim report of the proceedings of the fifth annual meeting at Leipsic, in April. The presidential address by Oswald was brief, and referred only to the business of the society; there are now 553 members; the society has been in existence almost four years. The next annual meeting is to be at Aix-la-Chapelle. (The papers read will be noticed under separate headings.)

ELECTRICITY DIRECT FROM COAL.—"Scientific Machinist" (Cleveland), May 15.—A reprint of a thesis by Rosewater and Oldham, describing experiments with the Jacques battery. The experiments were made under the direction of Prof. J. W. Langley, in order to find out what there was in the astonishing proposition of the inventor of that battery; they endeavored to determine what could be done with this battery in a practical way, with commercial materials. In a lecture on the subject by Langley, a brief notice of which precedes the article, he stated that there could be no doubt at all of the soundness of the conclusion that Jacques was mistaken; that his battery was not a chemical battery, but a thermo-electric one, as was shown originally by Reed, and that the principle claimed to have been discovered was really very old, and finally that the battery cannot begin to compete with a steam boiler and engine in efficiency of conversion. In the thesis it is stated that the battery is the same as that of Jablochkoff of 1877, except that the alkaline hydrate is used by Jacques instead of the alkaline nitrate. A brief, illustrated description of the battery is given. The efficiency claimed by Jacques, namely, 82 per cent., means nothing, and is misleading, as it does not include the carbon consumed outside of the pot to heat it. The apparatus constructed by these experimenters is illustrated and described, and the curves of results, showing the temperature and voltage curves throughout the period of tests of about four hours, are reproduced; seven experiments were made with copper, iron and carbon rods, in each case with and without the air blast, and finally one with a carbon rod and sodium nitrate without the air blast; these curves approach and recede from each other; that is, when the temperature goes up the voltage drops, vice versa; curves of the amperes are not reproduced. In conclusion they say that the experiments show beyond a doubt that the cause of the current is thermo-electric; the general aspect of the curves is characteristic of thermo-electric curves; the maximum voltage occurs when the difference of temperature is greatest, as at starting or stopping the flame; if the action were chemical, the addition of oxygen would cause the curves to be more negative, which, however, is disproved by the results; the addition of air, if the cause was thermo-electric, would increase the voltage at starting and stopping, as was shown to be the case by the experiments; this also explains why, as Jacques himself stated, ordinary illuminating gas gives the same results as air. (The compiler calls attention to the effect of reversing these curves, as was shown recently in Reed's Institute paper, that particular portion of which is reprinted in the "Elec. Rev.," May 25.)

SODA PROCESS.—"Eng. & Min. Jour.," May 21.—A brief, illustrated description of the Widnes installation (England), in which the Hargreaves-Bird process is used; this has proved a success, and has been worked at a profit during 1897, although the plant is but small; illustrations and some data are given.

Units, Measurements and Instruments.

STANDARDS OF LIGHT. Laporte. "L'Eclairage Elec.," May 14.—An abstract of a recent paper read before the International Society, describing his comparisons of the carcel and the hefner

standards. After a review of the history of the question of photometric standards, he gives the results of his comparisons, in which he assumes that the carcel is equal to 9.6 bougie decimale (the decimal candle is equal to 1-20 of a violle and approximately equal to the English standard). A table containing the values of each in terms of each of the others is given; in this the hefner is equal to 0,885 decimal candle, and the paraffin candle to 1.05 decimal candles; (there is an important typographical error in this table, the value of the hefner unit in terms of the carcel being evidently 0.092 and not 0.92); from this the relation of the hefner unit to the carcel is much lower than that usually assumed. This is followed by a discussion by Blondin; he claims that this clearly establishes the relation between the hefner and the carcel as being equal to 0.092; various relations are calculated, and it is said that some independent and unpublished researches give the ratio as 0.093, thus confirming this figure. It is generally admitted that the hefner unit differs but very little from the decimal candle, the generally adopted value being 1.02 decimal candles, and the question arises how this difference of 15 per cent. can be explained; he believes it will be found by a more careful determination of the ratio of the carcel to the violle and of the hefner and the violle. In countries where the hefner unit is the standard a lamp of 16 candle power would correspond actually to 18.2 hefners in France, where it would be called a 16 candle power lamp; that is, that in France a lamp of nominally the same candle power would have 15 per cent. greater power, and comparisons of the amount of energy required should, therefore, take account of this difference. A brief abstract of Laporte's paper is published in "L'Ind. Elec.," May 10.

ACETYLENE STANDARD OF LIGHT. Fery. "L'Ind. Elec.," May 10; more briefly in "L'Eclairage Elec.," May 7.—An abstract of an Academy note from the "Comptes Rendus," p. 1192, in which he describes a simple apparatus.

ELECTROLYTIC METER. Bastian system. Lond. "Elec. Rev.," May 13.—A brief, illustrated description of this meter, the claim for which is cheapness, its cost being only about half that of the ordinary meters; it appears to be limited to small currents. It consists of a glass tube open at the top, with the electrodes at the bottom, and provided with a graduating scale like a thermometer; it contains acidulated water, which does not freeze; a layer of oil at the top prevents evaporation; the level of the liquid indicates the reading on the scale directly in kw hours. It is calibrated by pouring into it the quantity of water which would be decomposed by 25 kw hours, making a mark and repeating this until the tube is filled, the spaces being then divided into twenty-five equal parts. (Nothing is said about the comparatively large voltage required, nor that it is apparently limited to direct currents.)

MAGNETIC OBSERVATORIES AND TRACTION CURRENTS.—"Elek. Zeit.," May 12.—An editorial commenting on the requirements of the managers of the observatory at Potsdam, Germany, that no electric railways using the earth as a return circuit should be allowed to approach within 9 miles of that observatory. The second observatory in Germany, near Munich, recently feared disturbances from electrical railways, one of which runs to within 217 m of the observatory; but tests showed that decided disturbances were not caused by the railway currents, and permission was therefore granted to run the line, with the understanding that if they were found to exist the line is to be run with accumulators; a maximum disturbance of 0.1 minute of arc was agreed upon. The case in Washington is mentioned, in which the railway approaches within 1400 feet of the observatory, but in this case the observatory was built after the line existed. The case at Toronto is also referred to; tests there have shown that disturbances will not be appreciable if the distance is not less than 2 miles. It is therefore argued that to require a distance of at least 9 miles is unnecessarily severe.

WORKSHOP PERMEABILITY BALANCE. Ewing. "El'ty," May 25.—A reprint of his paper read before the Institution of Elec. Eng. (London). He describes what appears to be a very interesting and practical form of magnetic balance for workshop tests of permeability by means of which a test may be easily and rapidly made. His bridge, introduced some two years ago, is entirely suitable for comparing one bar with another through a wide range of magnetizing forces, but this is more than the dynamo builder generally wants to know, and it would often suffice to find the induction produced by only one fairly high value of the magnetizing force; this is what is done in the present balance, in which no knowledge of electrical testing and no working out of results is required, the value of the induction, B, being read off directly. It is an instrument of the traction type, but differs from others in that no facing at the end of the sample is required, the magnetic pull being exerted at the side of the bar. The specimen is a turned rod ¼ inch in diameter and 4 inches long; it lies across the two poles of a U-shaped electromagnet, excited by a constant current, which produces a magnetizing force of $H = 20$ C. G. S. units; one pole has a V-notch for the bar to rest in and the other has a slightly convex cylindrical surface, the axis of which is perpendicular to that of the rod; thus the contact is at one point only and the force at that point is what is measured: a weighing beam is used to pull off the rod, the other end of which is hinged in the V-notch, and the tractive force is measured by the weight. The current is first reversed once or twice to wipe out any residual effects, and the weight is then adjusted until the beam just drops every time it is raised. The rod may be taken out and put back without altering the character of the contact. A magnetizing force of 20 units was used, because below this the curves of different specimens often cross and their order of merit changes, which is not the case above this value; a considerably greater force would be less convenient, because the differences between specimens would be less marked and the sensitiveness of the test reduced. The following table shows the probable approximate values of B at various forces when that at $H = 20$ is known; in dynamo steel the value of B for $H = 20$, varies from 16,000 in the very best specimens down to 12,000 in those of decidedly low permeability; 15,000 is representative of good dynamo steel castings, and anything below 14,000 is pronounced poor. The range of the balance extends from 12,000 to over 16,000, and will test the best samples that are found, as well as those of poorer quality than would be accepted for dynamo magnets; the scale is a linear one, and reads directly in values of B. A single standard is supplied with each instrument, and the observer adjusts his current until the tractive force is such that a slight weight on the beam corresponds to the value of B, which corresponds to a force of $H = 20$ in that standard; thus this standard serves the purpose of an amperemeter; a rheostat and a single small storage cell are all the additional apparatus required. Another table gives a comparison of values for a number of different rods determined by this and by other methods, and shows an agreement which is of sufficient accuracy for all practical purposes.

Probable Values of Magnetic Induction, B, for Various Amounts of Magnetizing Force, H.

Magnetizing Force, H.	Magnetic Induction, B.				
20	12,000	13,000	14,000	15,000	16,000
25	12,700	13,700	14,600	15,500	16,350
30	13,300	14,200	15,100	15,900	16,600
40	14,200	15,000	15,700	16,400	17,000
50	14,900	15,600	16,300	16,900	17,400

THERMOPILE.—"Elec. Rev.," May 25.—A brief description of the new pile of Reubens, which was described in the "Digest," May 14.

Telegraphy, Telephony and Signals.

WIRELESS TELEGRAPHY.—Lond. "Elec.," May 13.—An editorial deploring the name, preferring "Hertzian telegraphy" or "wave telegraphy," and calling attention to several practical difficulties involved in such systems. The most serious obstacle to its extensive use is that the energy is scattered profusely in all directions, only a minute portion being received, while in all other methods of conveying messages the energy is confined to a restricted path; no such method of working is used at present, or is likely to be developed soon. At a distance of 1 mile the fraction of the total energy received on 1 square foot is less than one three hundred and fifty-millionth of the total energy radiated; at a distance of 100 miles one erg per square foot of resonator plate at the receiving end would necessitate an expenditure of 1 kilowatt for more than a minute, while for telegraphing from London to New York the original energy would have to be equal to 156 kw hours. There are well-known substances, like pitch, for instance, which, when formed into a lens or prism, have the power of acting on such waves like lenses or prisms of glass on ordinary light, but it appears to be difficult to apply these to wireless telegraphy; it is thought, however, that it will ultimately be necessary to use some such device, and until this is done the sphere of usefulness of such a system will continue to be one of small radius, although within that distance it may do excellent service.

ELECTRICAL ENGINEERING AND THE WAR.—Lond. "Elec.," May 13.—A short editorial inspired by the present war. The British Admiralty has made provision that some of the officers should understand cable working and be in possession of the necessary appliances, so that when a cable is cut by belligerents the ends can be made use of; moreover, there are British cable ships with cable on board, and there are store cable tanks in various parts of the world; it is probable that their fleets in time of war would be accompanied by a cable ship of greater capacity and higher speed than is necessary for the ordinary operations of vessels of this class. It has been argued that for strategic reasons submarine cables ought always to be laid in deep water, to which it replies that wherever a cable can be repaired at all it can be more easily broken; cables have been repaired at a depth of not less than 3 miles.

TELEPHONY IN AUSTRIA. Hellrigl. "Zeit. fuer Elek.," May 8.—The conclusion of his long article. The present portion contains two large tables, giving detailed information, showing the development from 1881 to 1897.

SIGNALS AT RAILROAD CROSSINGS. Kohlfuerst. "Elek. Zeit.. May 12.—An illustrated description of the Hattemer and a brief one of the Neumann systems, used in Germany for ringing bells at grade crossings where there is no attendant.

AUTOMATIC TELEPHONY IN ENGLAND.—"West. Elec.," May 21.—A short, illustrated description of a system which is being introduced in England, one for small and one for large stations.

Miscellaneous.

TEST OF A COOKING APPARATUS.—"Elek. Anz.," May 8.—The tabulated results of a carefully made test by the Reichsanstalt, of an apparatus for boiling water. The vessel, which was of the enameled kind, had a capacity of about 2 quarts; the first test was made while the water was being brought to nearly the boiling

temperature; various quantities of water were used, and the efficiency varied from about 85 to a little over 88 per cent. In the second test the efficiency was measured while the water was boiling; in this test the time was taken which is required to vaporize known quantities of water; the vessel was suspended on a balance during the test, and the amount of water evaporated was 500 gr. (about 1 pint); the efficiencies in the seven tests varied between 89.1 and 90.7 per cent.

ELECTRIC FURNACES. Richard. "L'Eclairage Elec.," May 7.—Brief, illustrated descriptions of a number of furnaces, taken from patent specifications.

GOVERNOR FOR PROPELLER ENGINES. Putato. "L'Elettricita," April; abstracted in "L'Eclairage Elec.," May 14.—A description of a governor used on the steamer Gottardo. It consists of two tubes containing mercury and connected at their bottoms, into one of which dips a series of wires, one shorter than the other and connected to a rheostat so that a change of level of the mercury by the pitching of the vessel will short circuit successive steps in the resistance, the current passing through this being used to operate the steam valve of the engine.

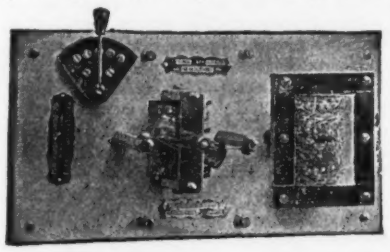
FIRING MINES ELECTRICALLY.—Lond. "Elec. Eng.," May 13.—A short anonymous article discussing the various factors involved in this method of firing mines and pointing out the advantages over the fuse method; the cost of the two methods is stated to be about equal, but about twice as much work can be done per day by the electrical system.

PRODUCING HIGH TEMPERATURES WITH ALUMINUM. Goldschmidt. "Zeit. f. Elektrochemie," May 5.—A reprint in full of the paper, an abstract of which was noticed in the "Digest," last week.

OZONIZERS.—"Elec. Eng.," May 19.—Illustrated descriptions of the Andreoli forms. The first one consists of a vacuum tube containing a metallic rod and surrounded by an aluminum armature; when subjected to about 4000 volts the tube becomes luminous and ozone is generated around it. The second kind consists of a grid of serrated wires of aluminum, and another of a flat sheet of aluminum, the two being separated by sheets of glass. The construction is very simple and no skilled labor is required to install or use it. These produce about 125 gr. of ozone per kilowatt, and supply ozone at about $1 per 11 pounds; there is no circulation of water for cooling purposes; excessive heating is avoided (how, is not described); the point bearing grids face the flat electrodes.

A Battery Telephone Generator.

The W. F. Warner Company, Muncie, Ind., has brought out a novel telephone generator designed for telephone exchange use. It can be operated by batteries as well as by electric light current, and has ample capacity for exchanges of less than 1200 'phones. The power required to operate this machine is about .3 ampere at eight volts.



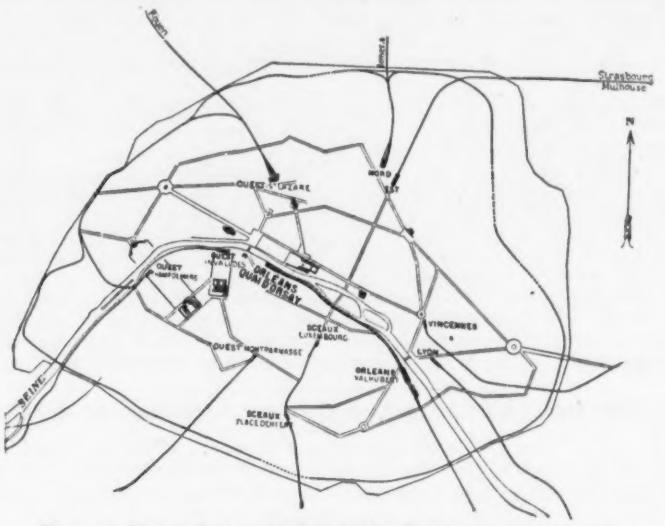
TELEPHONE GENERATOR.

Most telephone exchanges throughout the country do not have access to lighting circuits, and many large exchanges have been compelled to use the hand generator, owing to the fact that they had no means to operate a separate or power generator. This new battery generator therefore fills a long-felt want, and the price brings it within reach of all exchanges.

Heavy Electric Railroading Proposed in France.

An enterprise involving the expenditure of not less than 40,000,000 francs, or $8,000,000, and the creation of a road about 2½ miles long, partly underground, operates about 4300 miles of track in the West and Southwest of France, is at the Place Valhubert, near the Pont d'Austerlitz and the Jardin des Plantes, in the extreme east of Paris. The traveling population of Paris does not live in the eastern part of the city, but in the western, in which direction the city is steadily growing, and access to the present Orleans station in most cases involves carriage transportation. The Orleans Company has therefore decided to prolong its line into the very heart of Paris, and for this purpose has secured a right of way underground to a point on the left bank of the Seine, opposite the Garden of the Tuilleries, where it will erect a terminal station.

The new road will have two tracks and will drop from the Valhubert station on a grade of 1.1 per cent. toward the Seine. Here the river banks are in two stories, an upper quay or roadway, and a lower quay used as a dock or wharf



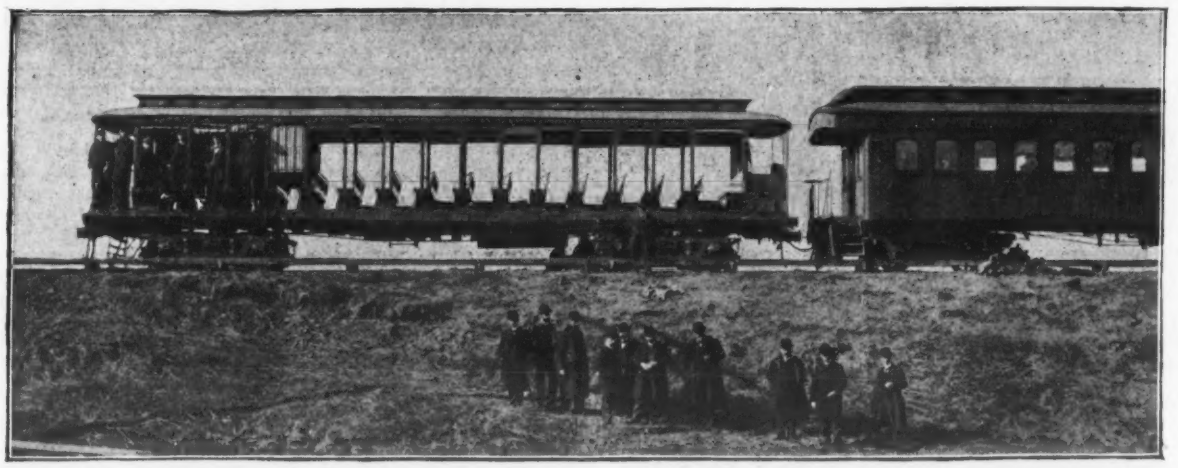
MAP OF PARIS SHOWING PROPOSED RAILWAY EXTENSION.

for canal boats. A belt 9 metres wide has been secured on this lower quay and the line will follow this in the open for 6500 metres. It will be an underground road beneath the upper quay for the remainder of the distance until it reaches the terminus under the Cour des Comptes. Openings in the wall side of the quay facing the river will afford light and ventilation.

In driving the underground tunnel the Orleans Railroad will operate without interference whatsoever with the street traffic. The earth overhead will be supported by a metal shield pushed forward by hydraulic presses and followed closely by the masonry. The method is similar to that employed in building the great sewer recently laid down in Paris.

The operation of this underground road, as at present contemplated, is to be carried on by means of electric locomotives driven by continuous current at a pressure of between 500 and 700 volts, using the third-rail system of contact. In asking for estimates, however, the company has requested bidders to submit plans also for the use of systems of generation and distribution other than that just mentioned. The locomotives are to be eight in number, all alike, and able to haul a train of 250 French tons in 7 minutes between the stations of the Quai d'Orsay and the Pont d'Austerlitz, without stopping at the intermediate station of the Pont St. Michel. This means a speed of 45 kilometres (28 miles) an hour. The locomotives should not only be able to haul a train of the weight mentioned on a grade of 11 millmetres (1.1 per cent.), and on curves of 200 metres' radius, but it should also be able to haul trains as heavy as 300 tons at a slower speed. The locomotives must be built to move in either direction, at the same speed, and be of a length to allow them to be turned on turntables 6 metres 20 centimetres in diameter. They are to be equipped with motor-driven air pump and air brakes.

In order that a better knowledge of the operation of electricity in heavy traction service might be gained than was possible in Europe, the Orleans Company recently sent over to America a corps of engineers to investigate



GROUP OF FRENCH ENGINEERS AND THE TEST TRAIN.

to be operated exclusively by electricity, is about to be undertaken in the city of Paris by the Orleans Railroad. The main terminal of this railroad, which the different electric railway installations of this type in this country. The party was headed by E. Solacroup, Assistant Chief Engineer of Material and

Traction, and M. Sabourot, the other members being Messrs. Hiberly, Fremenville and Walton. Their inquiries were conducted very quietly, but during their short stay they were able to visit almost every installation of special interest to them in the United States.

A special test was arranged for their benefit at Schenectady on the experimental 2-mile track of the General Electric Company, the conditions of the track and load being, as far as possible, similar to those which will obtain on the line in Paris. A length of track was marked off 1.11 of a mile long, by two white flags corresponding to the distance between the Quai d'Orsay and the Pont St. Michel stations, the most difficult portion of the proposed Orleans extension. According to the time schedule arranged for the operation of the road this distance should be covered in three minutes and fifty seconds. A train was made up of a motor car of the Nantasket Beach pattern, equipped with four G. E. 55-175 hp motors as locomotives, several New York Central coaches and seven flat cars loaded with pig iron, making a total train load of 320 tons, including the motor car, which weighed 45 tons. The run between the flags, including starting and stopping, was made easily in three minutes and twenty-five seconds, giving a margin of not less than twenty-five seconds to the good.

The question of rendering the third rail innocuous after the passage of the train having been brought up, the General Electric Company arranged an exhibition of its method of effecting this result.

The motor car was run over that part of the track beside which the third-rail was sectioned, and as a visual means of indicating that the third rail was alive a number of incandescent lamps on the top of the boxes containing the switches were connected to the conductor. As the car reached the sections and rendered them alive the lamps lighted up, being extinguished as the contact shoes passed over the dividing lines between the different sections.

These tests formed the subject of the concluding investigations of the French engineers in this country. They admitted having received many new ideas during their stay, and return to France convinced of the use and possibilities of electricity as a motive power, especially in the field of heavy traction.

Electric Gas Lighting Attachment for Incandescent Burners.

To use an old and threadbare phrase, there has been a "crying demand" for a practical and low price method of lighting incandescent burners by electricity. This demand has been created by the inconvenience of lighting this

Electric Gas Lighter.

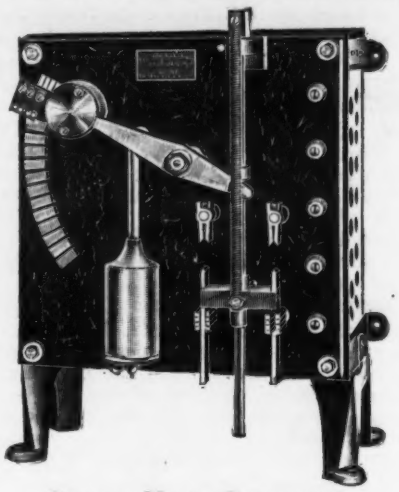
burner when it is used on high chandeliers; and in the chain pull style, by the great danger of breaking mantles from the jar caused by operating the same.

To meet this demand an attachment has been designed which embodies the improvements found in the "Advance" electric gas lighting burner. Among these are smooth, easy action in lighting, which will not break the mantle; its operation by key in the same manner as the ordinary gas cock, and the fact that there is no possibility of the burner becoming short circuited in extinguishing. An additional feature is an adjustment in the pilot tube, by which the size and height of the pilot flame can be regulated. This prevents the blackening of the mantle, this blackening being frequent in burners lit from a pilot tube where too large a flame issues from the same. The attachment can be used with the genuine Welsbach, as shown in illustration, and a majority of the other incandescent burners now on the market. It is said to require but a few moments to attach. Stems are furnished in any length, but are sent 4 inches long unless otherwise specified.

The Electric Gas Lighting Company, 194 Devonshire Street, Boston, Mass., is the manufacturer of this device, which, it is stated, is meeting with a ready sale and gives the best of satisfaction.

Gravity Motor Controller.

The device represented in the accompanying illustration possesses some meritorious features. It is simple in design and durable. Few parts enter into its construction, and repairs, therefore, are easily effected. Particular attention is called by the manufacturer, the Electrical Appliance Company, 27 Thames Street, New York City, to the contacts and the use of a non-conduct-



Gravity Motor Controller.

ing device for securing tension. The controller can be readily attached to belted elevators by making rod connections direct from the belt shifting wheel or a wheel operated from the same. This controller can be used for starting an elevator and motor simultaneously and for starting the motor in advance of the elevator, but still retaining the automatic cut-off feature. It may also be used for starting and stopping the motor independently of the elevator. These controllers are made in sizes varying from 3 to 50 horse-power, and are designed for the control of elevators, motors, pumps, presses, etc.

Jagabi Portable Testing Set.

The Jagabi portable testing set, recently placed on the market, is claimed to be the simplest, lightest in weight and most compact instrument of its class which has yet been made. It has outside dimensions of 9½ inches x 5 inches x 4 inches, and weighs about 7 pounds. The apparatus comprises a highly sensitive D'Arsonval galvanometer, Wheatstone bridge, rheostat, silver chloride battery and keys for both galvanometer and battery, all mounted in a handsomely finished mahogany case, with lock and handle. This combination makes a convenient piece of apparatus for use in making all classes of resistance measurements that come within its range. The general scheme of arranging the different parts is shown in diagram, Fig. 1. From this it will appear that the rheostat has sixteen coils, ranging from one to 4000 ohms, and having total capacity of 11,110 ohms. The bridge arms are 1, 10 and 100 ohms on one side, and 10, 100 and 1000 ohms on the other side. A unique reversing device enables the same result to be obtained with the bridge as if four pairs of coils were on each side. Six cells of chloride of silver battery are provided, these being sufficient for all ordinary requirements. When specially high resistances are to be measured, an outside battery of greater capacity should be used. An important improvement to be noted in connection with the galvanometer is a small exterior milled head screw, by means of which the zero

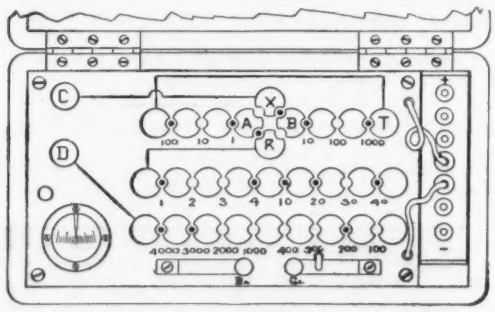


Fig. 1.—Diagram of Testing Set.

may be adjusted in case of any small change of tension in the spring. This feature will be much appreciated by those familiar with testing sets. The apparatus is so arranged that the rheostat coils may be used by themselves; the galvanometer may be used independently; the galvanometer and battery connected in series may be used without the rheostat and bridge, or the galvanometer, battery and rheostat may be connected in series. Thus every possible combination is provided so that, practically speaking, each distinctive part of the set may be used alone, or in connection with the other parts, as desired. By means of traveling plugs, any coil or group of coils may be isolated, or used for a derived circuit. By a simple arrangement of the plugs the set may be used to measure high insulation by the direct deflection method.

The Jagabi portable testing set is manufactured by Messrs. Elmer G. Willyoung & Co., Philadelphia, for which firm James G. Biddle, No. 910 Drexel Building, Philadelphia, is sole selling agent. Mr. Biddle has just issued descriptive pamphlet No. 295, relating to the above apparatus, and will take pleasure in sending copies to those that write for it. The Jagabi set has not been on the market long, but is already meeting with much favor. An order for ten instruments was recently filled for the United States Government.

NEWS OF THE WEEK

Financial Intelligence.

THE DIAMOND ELECTRIC COMPANY, Peoria, Ill., has certified to the Secretary of State to an increase of capital stock from $60,000 to $100,000.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, May 31, 1898.

DINNER OF THE NEW YORK ELECTRICAL SOCIETY.—On Friday evening, May 27, the New York Electrical Society, at the St. Denis Hotel, in this city, inaugurated the custom of an annual dinner. There was a very satisfactory attendance, and toasts were responded to by the following named gentlemen, Mr. T. C. Martin acting as toastmaster: "The New York Electrical Society," Gano S. Dunn; "The American Institute of Electrical Engineers," Prof. F. B. Crocker; "Sister Societies," Dr. William McMurtrie; "The Yankee Militant," Captain Zalinski; "Electrical Applications," Frank W. Jones; "The Newspaper Man," Stephen L. Coles; "The Electrical Manufacturer," H. Ward Leonard; "What We Think of Electrical Engineering," C. O. Mailloux; "The Technical Colleges," Joseph Wetzler.

PROPOSED NEW STREET RAILWAYS.—Three new street railway companies have applied to the State Railroad Commission for permission to construct lines in this city. They are the North End Street Railway Company, the Fort George & Eleventh Avenue Railroad Company and the Kingsbridge Railway Company. The first named has a capital of $5,000,000, and desires to construct a road 13 miles long, with termini at the intersection of Manhattan Avenue and 116th Street, and at the intersection of Kingsbridge Road and the northerly line of New York City, with numerous branches. The Fort George line contemplates the construction of a road 1500 feet long on Eleventh Avenue, between Kingsbridge Road and 175th Street. The capital of the company is $10,000. These two companies, it is stated, are backed by the Metropolitan Street Railway Company. The Kingsbridge Railway Company desires permission to construct a road 8 miles long from the intersection of Manhattan Street and the Boulevard, running along the latter thoroughfare to Kingsbridge Road and from the junction of Amsterdam Avenue and Kingsbridge, connecting with the existing road on Amsterdam Avenue at 162d Street, thence along Kingsbridge Road to and upon the Harlem Ship Canal Bridge and over the proposed bridge across Spuyten Duyvil Creek to the northernmost point of intersection of West 230th Street with the Kingsbridge Road, thence along 230th Street to and along Riverdale Avenue to the city line. This will be a connection of the Third Avenue Railroad Company.

MORE UNDERGROUND CONDUIT ROADS.—Applications have been made to the State Railroad Commission by the Metropolitan Street Railway Company and the Third Avenue Railroad Company for permission to change the motive power on the various lines owned by these two companies not now operated by electric power. These changes, it is stated, will cost more than $30,000,000, and will be made as soon as the consent of the commission is obtained. They will cover about 150 miles of street surface roads. A hearing on the applications was set down, to be held at the Fifth Avenue Hotel, New York City, on June 2, at 2 P. M. The applications ask that certain specified roads be allowed to operate on the underground conduit, storage battery or compressed air system, though it is thought that the underground conduit system is the power that will be adopted by all. The lines to be equipped by electric power include the Broadway, Lexington Avenue and Columbus Avenue lines of the Metropolitan Company, all of which are now operated by cable power. The Third Avenue line and the 125th Street line, both of which are cable roads, are also included in the petition for electric power equipment. The Forty-second Street, Manhattanville and St. Nicholas Avenue line, and the Dry Dock, East Broadway and Battery road, both of which are operated by the Third Avenue Railroad Company, have already received permission to use the underground conduit system. The Twenty-eighth and Twenty-ninth Streets Crosstown road, the Thirty-fourth Street Crosstown, the Central Crosstown, the Belt line, the Fulton Street line, the Forty-second and Grand Streets Ferry line, the Bleecker Street line, the Avenue C line, the Metropolitan Crosstown, the Chamber Street line, the Ninth Avenue line and the remaining parts of the Second, Sixth and Eighth Avenues lines and the Broadway and Seventh Avenue road are all included in the Metropolitan Street Railway Company's petition. If the applications are approved by the commission, not only horses as a means of motive power on street surface roads on Manhattan Island, but cable power as well will become things of the past after the improvements have been carried out. It is stated that when all these improvements have been completed it is the intention to effect a partial rearrangement of service and bring about an interchange of traffic between the Metropolitan and Third Avenue systems that will produce the greatest possible degree of efficiency. It is also stated that the general introduction of the underground conduit system on the street railway lines in the Borough of Manhattan is a step toward the future consolidation of the street railway and elevated railway interests. The elevated railway system, when it has been equipped with electric power, can then derive its power from the same stations that supply the surface lines.

PHILADELPHIA NOTE.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., May 28, 1898.

A HARD WORKED PLANT.—It is not often, especially in an isolated plant, that a dynamo has to operate continuously six and a half days in the week and every week in the year, but this is what a 60-kw C & C generator, direct connected to an Ideal engine, is doing at the chemical works of Harrison Brothers, in Philadelphia. This plant was set up early last fall, and the generator was one of the first of the C & C Electric Company's present type installed. The work it is called upon to perform is unusually severe, and it is only shut down for a few hours on Sundays, yet the dynamo, it is stated, has been doing its duty admirably. In addition to furnishing the lighting for the buildings the generator supplies current to drive several C & C closed type ironclad motors, one of which is placed outdoors and bolted to a brick wall. The installation is a very complete and interesting one, beside being in every sense modern.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., May 28, 1898.

NEW YORK CAPITALISTS are asking for a franchise to enable them to build an electric railway in Niagara Falls. The applicant is a Mr. Serrell, who is not known in this vicinity. As all other applicants for a second franchise have been refused it is supposed that this one will share the same fate.

THE THIRD ANNUAL CONVENTION of the Fire and Police Telegraph Superintendents and Municipal Electricians will be held at Elmira, N. Y., on August 9 and 10 next. Several papers will be read by well-known electricians. Mr. W. Y. Ellett is the president of the association composed of these municipal officials.

THE CONTINUED TESTS of the new circuit breakers at the Niagara power house have all been very satisfactory to both the Westinghouse and General Electric Companies. The spectators are said to have become somewhat nervous as the tests proceeded, but the interested members of the party were more than pleased. Some very satisfactory photographs of the arc formed have been obtained.

A VERY INTERESTING and satisfactory test of the current received in Buffalo from Niagara has just been made. The spare cable, which is kept in readiness to meet an emergency, was subjected at first to a pressure of 22,000 volts. Then the pressure was run up to 45,000 volts, without any difficulty or apparent disposition of any part of the cable or insulators to show weakness. As this pressure affords such a wide margin over the actual demand on the line as now operated, it is felt that the danger of overloading is very remote.

THE ELEVEN TRANSFORMERS for the Wilkeson Street sub-station of the Niagara tunnel current are finished and nine more have been ordered. With them all in position the high-tension current can be reduced to meet the needs of any city customer. The delay in this work on account of so much Government work that cannot wait is now increased by the taking of some of the best experts from the General Electric Company into Government service direct, fairly crippling the work in some respects. The Buffalo Company is fortunate in having no one that is subject to such a call.

THE ELECTRIC MACHINERY has been ordered for the Urban flour mill at last. It consists of a 400-hp synchronous motor for the mill proper; one of about 75 horse-power for the fire pump and two of about 25 horse-power each for the elevator and storehouse. The General Electric Company will furnish the apparatus. The company is of course congratulating itself on account of coming out ahead of other bidders who made about the same prices, but pinned their faith on induction motors. The General Electric Company insists that a synchronous motor is better adapted to this work, especially on account of the necessity of a perfectly uniform speed. It is expected that the mill will be changed over to electric power by August. The current will be transformed from the 11,000 voltage at which it is now received from the Niagara tunnel to 220 volts by the transformers in the Wilkeson Street station in this city, so that the mill will need only to transform the currents that are used for lighting and running the small motors.

ST. LOUIS NOTES.

ST. LOUIS, Mo., May 26, 1898.

THE PEOPLE'S RAILWAY will not be sold under the foreclosure decree of the Circuit Court. The Supreme Court in banc has reversed and remanded the judgment of the lower court. This will not affect the receivership of the road.

THE SUPREME COURT in banc on Tuesday dismissed the quo warranto proceedings to oust the Central Traction Company from doing business in St. Louis for alleged violation of the Julian franchise law. The court stated that the proceedings against the defendant company were premature, and hence ordered them dismissed.

KINLOCH TELEPHONES.—August 1 is the day the new Kinloch telephone system is to be inaugurated. By that time 4000 subscribers will all be connected with the main office. In July the telephone operators will be broken in, so that they will be capable of attending to the duties required of them on the inaugural day.

AN ELECTRIC RAILWAY will be guilt from Michigan City to Danville, Ill., via Lake Maxinkuckee, Momenee and Covington. Engineers who have gone over the route decide the plan feasible, and cheaper than was at first calculated. The road will afford a cheap and direct means of reaching the Northern health and pleasure reports, and of sending grain to the lakes.

APPLICATION FOR A TELEGRAPH LINE EXTENSION.—The receiver of the St. Louis, Kansas City & Colorado Railroad filed an application in the United States Circuit Court last week for authority to contract with the Postal Telegraph & Cable Company to erect and maintain a line of telegraph between St. Louis and Union, Mo. The distance is about 60 miles. The matter will be heard in a few days.

THE BELLEVILLE LINE OPENED.—The Suburban Electric Railway between East St. Louis and Belleville was opened May 22. Hundreds of citizens passed over the line. The cars run down as far as the Belt Railway, and from there the passengers are transferred in 'buses to the bridge. This part of the line will be constructed immediately by the Terminal Railway Company, which owns the East St. Louis lines.

Colorado Notes.

Denver, Col., May 25, 1898

FREE TRANSPORTATION FOR SOLDIERS.—The Denver Tramway Company has been carrying free all the members of the National Guard in camp in Denver, when in full uniform. As the camp is on the outskirts the privilege of riding to the city without paying fare was greatly appreciated by the soldiers.

FRANCHISE NOT GRANTED.—No action has yet been taken on the ordinance granting the cable railway company the right to substitute electric power for the cable. It is to be hoped that the desired permission will soon be granted, as the improvement is one demanded by the public and urgently needed by the company, as a reduction in operating expenses is a condition precedent to its meeting its obligations.

CONSOLIDATED ELECTRIC ELECTION.—The Denver Consolidated Electric Company has elected the following named officers: President, E. W. Rollins; vice-president, A. S. Hughes; general manager, John H. Poole; secretary and treasurer, T. H. Reynolds; directors, A. S. Hughes, H. T. Rogers, F. A. Keener, E. L. Foster, J. H. Poole, T. E. Poole, T. H. Reynolds, G. H. Taylor, A. E. Greer, E. W. Rollins and H. K. Devereux.

CITY FIRE ALARM SERVICE.—The fire alarm system of Denver is at present in a demoralized condition. It has been discovered that many wires now laid underground are grounded and inoperative. The city electrician, M. L. Stern, recommends that the underground wires be replaced by aerial cables until such time as a complete system of subways is constructed. These cables will be strung as soon as the city makes the necessary appropriation.

NEW ELECTRIC LIGHT AND POWER PLANT.—An electric light and power plant is to be installed in San Miguel County by a company of which David Swickheimer, A. J. Clark and Walter B. Beam are the principal members. The site of the plant is near Telluride, and its capacity, it is announced, will be about 1500 horse-power. The plant will be operated by water power. Work on the station is soon to be commenced, and the digging of the ditch for the flume is now well under way. It is said that the new plant has been promised patronage from some of the largest mining companies in the district.

NOT RESPONSIBLE FOR DELAY OF MESSAGE.—The Court of Appeals has reversed a judgment obtained by Norman C. Barwise, of Pueblo, Col., against the Postal Telegraph Company. The plaintiff, who is a merchandise broker, lost a sale because a telegram which he had sent to Los Angeles was not delivered on time. He sued for the commission he had failed to make, and in the District Court recovered $266. In reversing the judgment the Court of Appeals said of telegraph companies: "They cannot be treated as absolute insurers against mistakes in the transmission of messages, nor delays in their prompt delivery, except in so far as they so create this relation by their own acts, so hold themselves out to the public or make themselves by their own rules."

DENVER CITY ELECTRIC LIGHTING.—Action has not been taken on the contracts for furnishing street lights for the next year in Denver. Contracts have been awarded heretofore to the Denver Consolidated Electric Company and the Denver Highlands Electric Light Company. When the renewal of the contracts was recently discussed the matter was postponed in view of the fact that O. E. Miller sent a letter to Mayor McMurray, offering to furnish arc lights at $5 per month. The street lighting question is held up pending the investigation of Miller's proposition. Miller has a shady financial reputation in Denver. He was convicted last year in the United States Court of kiting checks, with the result that one national bank was forced into bankruptcy. At present he is at liberty pending a new trial.

FENDER ORDINANCE IN DENVER.—The six months allowed the street railway companies of Denver in which to equip their cars with fenders expired on May 10, but the fenders have not yet made their appearance. C. K. Durbin, superintendent of the Denver Tramway Company, which operates the electric railway system of the city, states that as soon as possible the company will conform to the provisions of the fender ordinance. When this regulation was adopted by the City Council the Tramway Company was in the same position as railway companies in most of the cities of the country; it was unable to discover a satisfactory fender. The company decided upon the fender invented by McGaffrey, of Colorado Springs, and purchased the right of the patentee for all its cars. A contract for the manufacture of the necessary number of fenders has been awarded, and they will be applied to the cars as soon as possible. The cable company has not made as much progress as the electric railway company, but the manager states that as soon as possible fenders will be provided. Proceedings to recover penalties for non-compliance with the ordinance have been commenced against both companies.

Canadian Notes.

Ottawa, Ont., May 27, 1898.

THE CANADIAN MOTOR SYNDICATE is looking for a site for a factory, the purpose being to manufacture electric motor vehicles.

THE BELL TELEPHONE COMPANY has commenced work on its new exchange in the city of Quebec. The structure will be built of granite, and will cost upwards of $20,000. The switchboard will accommodate 3000 subscribers.

THE RAILWAY COMMITTEE of the Privy Council, at Ottawa, has granted a charter to the North Shore Electric Railway Company, which proposes to build a railway in the vicinity of Montreal, connecting Montreal with outlying districts. This road will run from Three Rivers, Quebec, along the north shore of the St. Lawrence. The promoters of this enterprise intend to use the water power of Shewanegan Falls for the generation of the necessary power wherewith to operate the road. This will be the bringing into operation of a system, long advocated, for the utilization of water power for cheap, rapid transportation between large cities and surrounding localities for the carriage of passengers and light local freight.

THE MONTREAL & SOUTHERN COUNTIES RAILWAY COMPANY, which obtained its charter last year, has been given power by the railway committee to extend its operations to the counties of Beauharnois, Chateauguay, Huntingdon and Napierville, Quebec. Its bonding powers were increased to $25,000 a mile, in addition to preference stock, $10,000 a mile. There are extensive powers for connecting with other railway companies or crossing the St. Lawrence, and for amalgamating with other companies, but the company is debarred from running along the streets of Montreal or the adjoining municipalities. Powers are also given to run steamers, maintain pleasure grounds and sell electricity for light, heat or power.

THE CATARACT POWER COMPANY, of Hamilton, Ontario, is engaged on an immense undertaking in the County of Welland, Ontario, for the purpose of generating electricity on a large scale, with a view of supplying power to any and every business industry that may require it in the line of route of upward of 40 miles. At the De Cew Falls a very large reservoir is in course of construction, the water for which will be supplied from the Welland Canal at Allanburg, which is itself fed from Lake Erie, and which stands at a considerable elevation above the site of the new reservoir. Seven or eight other storage reservoirs are being made between De Cew Falls and Allanburg, so as to have an abundant supply of water always on hand. At the De Cew Falls an immense power house has been erected, and the water will be carried from the reservoir through pipes 8 feet in diameter, the fall from the reservoir to the power house in the valley below being about 100 feet. This will give an immense amount of power, and will drive a large number of dynamos. The company proposes to sell the current all along the route of 40 miles to Hamilton for electric lighting or motors for manufacturing purposes, and will be prepared to increase the power at any time it may be required. The work is being done by contract, and at the De Cew Falls end there are some 200 men at work, with about 100 teams of horses, working excavators, etc. The job is to cost $1,000,000. The work has been going on for about eight months, and is expected to be completed some time in the coming fall.

French Notes.

(From Our Own Correspondent.)

Paris, April 28, 1898.

ELECTRIC TOWAGE ON THE SOUTHERN CANAL.—It is said that M. Pereice has conceived the idea of installing a system of electric traction on the Southern Canal. The overhead trolley, with a locomotive like a street car, will probably be the system that will be used. Should this project materialize this route would become one of the most important water ways of French navigation.

SMOKE CONSUMPTION IN FACTORIES.—The Municipal Council of Paris has approved the findings of the commission appointed to supervise the competitive exhibition of smoke consuming devices, which has been running since 1894. The prizes were awarded as follows: Two second prizes "ex aequo" of 5000 francs each, one to Mr. Donnelly and one to Mr. James Proctor; a third prize of 2000 francs was given to the Hawley Company; M. Dulac and M. Hinston received each honorable mention "ex aequo," and Messrs. Müller and Roger received a secondary honorable mention for their Orvis apparatus. The Municipal Council decided to have some extended trials made on these various inventions in a number of factories.

GENERAL ASSEMBLY OF THE SYNDICATE FOR ELECTRICAL INDUSTRIES.—The Professional Syndicate of Electrical Industries held a general assembly on March 22, followed by a banquet at which many invited guests were present. During the toasts, M. Ferdinand Meyer, president of the syndicate, made a speech, in which he drew a parallel between the development of electrical industries in France and Germany. This parallel, which was far from complimentary to France, was full of interest to all concerned in French industries. M. Meyer, with carefully prepared statistics and papers, was able to show his audience very clearly wherein German competition is endangering the French industries. It is to be hoped that our manufacturers will profit by this information and will make an effort to win back the territory which they ought never to have lost.

INTERNATIONAL SOCIETY OF ELECTRICIANS.—The society had a general meeting on April 6, M. d'Arsonval presiding. The elections were held, with the following results: President for the year 1899-1900, M. J. Violle; vice-presidents, Messrs. Clerac and Monnier; secretaries, Messrs. Abraham and Grasselin; treasurer, M. L. Viollet. Seventeen members of the executive committee were likewise appointed. M. J. Laffargue read a paper on "The Distribution of Electrical Energy in Germany." He opened with a general account of the central stations, of which there are 265, having a total capacity of 67,900 kilowatts. Two hundred and four are direct current stations; twenty-six are equipped for alternating current and sixteen for polyphase, fourteen for

both direct and polyphase and five for both direct and alternating single phase. This was followed by lengthy statistics on electrically operated roads, and the lecture was brought to a close with a statement of the receipts produced in a few cases.

RAILWAY SIGNALS.—A new system of electric signals for railways is being brought to the attention of the managers of the Paris, Lyons & Mediterranean Railway. The object of this system is to guard against all attempts at train wrecking. It seems that recently rails have been removed with this end in view. The stations are to be provided with a signal lamp, fed by current transmitted through the rails. This lamp will go out on the removal of a single bolt, no matter at what point on the line. Messrs. Chauvin and Baulan, engineers, have likewise proposed a complete system for protection of trains. This system would be in addition to the block signal system now in use, and would supplement it in such a way as to make all accidents practically impossible. Their system provides also a means by which the man in charge of a train which has become stalled may communicate by telephone or by telegraph with the nearest protective station. And in case these stations fail to work he can inform the trains which are following or approaching from the opposite direction which is the train that must be protected. The solution of the problem requires the combination of a closed circuit, maintained throughout the line between successive protective stations and a source of energy carried on each train, and so arranged that it may be introduced into the circuit at any point on the line. This closed circuit controls whatever warning instruments there are at the protective stations, so that directly anyone from the train in distress has inserted his source of energy in the circuit warning is at once given in the nearest station, either ahead or behind or even in both, and the employee at that station knows that the train must be protected. This closed circuit can also be made to control proper signals spaced all along the line so that trains approaching in either direction will be notified of the presence on the line of a train in distress.

A Few of the Exhibits at the Omaha Exposition.

THE OKONITE COMPANY, LIMITED, New York, will make a display of a complete line of its Okonite wires, cables, tapes, etc.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Newark, N. J., will have a very attractive exhibit of a varied line of measuring instruments.

THE GENERAL ELECTRIC COMPANY, New York, will occupy a space of 2500 square feet, and will have a display of its long line of apparatus, appliances, etc.

THE AMERICAN BELL TELEPHONE COMPANY will occupy a space of about 900 square feet, and will make an exhibit covering all the features of telephony, including a 500-drop switchboard on the express system.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., will be represented with an exhibit of the company's well-known products, large and small. The exhibit will cover a space of 2612 square feet.

THE WESTERN UNION TELEGRAPH COMPANY will maintain a regular commercial office on the grounds, and will, besides, make a special exhibit, showing the great variety of instruments used on its land lines and submarine cables.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, Ill., will make a detailed exhibit of its long line of apparatus in conjunction with the Western Electrical Supply Company, of Omaha. It will show its switchboards and long-distance telephones in practical operation.

THE AMERICAN ELECTRIC VEHICLE COMPANY, Chicago, Ill., will make a display of a complete line of electrically propelled vehicles, and will occupy a large space with its exhibit. This will probably attract considerable attention here because this branch of electrical application is new to the Western people.

THE OMAHA ELECTRICAL WORKS, Omaha, Neb., will join with the Otto Gas Engine Company in an exhibit which will be interesting as well as instructive. A 10-kw, direct connected, direct current, 104-volt dynamo, manufactured by the Omaha Electrical Works, will be driven by a 15-hp high-speed Otto gas engine.

THE FAIRBANKS-MORSE COMPANY, Chicago, Ill., will have an exhibit of several of its well-known gas engines, one of which will drive a 50-light, 105-volt, direct-current dynamo, direct connected to a gas engine. The dynamo is made by the Commercial Electric Company, Indianapolis, Ind. The combination will illustrate the practicability of such an outfit for electric lighting.

THE WESTERN ELECTRICAL SUPPLY COMPANY, Omaha, Neb., will have an exhibit of general electrical supplies. The display will include one direct-connected Crocker-Wheeler 5-kw, direct-current, 110-volt dynamo, driven by a Lewis gas engine, made in Beloit, Wis.; also a model telephone exchange. Some novel electrical effects in prismatic signs will also form one of the attractions. The Western Electric ceiling and desk fans and a full line of double and single-pole switches, etc., will be included in the exhibit, which will cover about 200 square feet of space.

General News.

NEW INCORPORATIONS.

THE ELECTRIC SUPPLY & FIXTURE COMPANY, Decatur, Ill., has been formed, with a capital stock of $2500.

THE CITIZENS TELEPHONE COMPANY has been incorporated at Medina, N. Y., with a capital stock of $21,000.

THE CARROLL COUNTY TELEPHONE COMPANY, Carrollton, Ohio, has been formed, with a capital stock of $10,000.

THE COPLAY, EGYPT & IRONTON STREET RAILWAY COMPANY, South Bethlehem, Pa., has been incorporated, with a capital stock of $60,000.

THE CREAGER ELECTRIC LIGHT & POWER COMPANY, Fremont, Ohio, has been incorporated by Frank Creager, J. H. Clauss, John M. Sherman and others. Capital stock, $50,000.

THE ARMY POST STREET RAILWAY COMPANY, Little Rock, Ark., has been formed, with a capital stock of $60,000. The incorporators are M. D. L. Cook, E. Meek, L. W. Cherry and others.

THE TELEGRAPH AND TELEPHONE.

HAGERSTOWN, MD.—The Maryland Telephone Company will extend its line to Downingsville, Fair Play and other points in the county.

BROOKLYN, N. Y.—The New York & New Jersey Telephone Company has obtained a permit to continue its work in burying wires, and will construct subways in various streets in South Brooklyn.

HUDSON, WIS.—Mr. A. T. Presson has sold to the Wisconsin Valley Telephone Company, of Menominee, Wis., his toll lines, extending from Roberts to New Richmond, from Baldwin to Hudson and from Hudson to Stillwater, Minn.

MANKATO, MINN.—The Mankato Citizens Telephone Company, which was organized in this city last winter, is about to commence operations with 175 subscribers' instruments for five years at $2 per month. The capital of the company is $10,000.

CAMDEN, N. J.—At the annual meeting of the stockholders of the South Jersey Telegraph & Telephone Company a board of directors was elected. The board subsequently organized by the election of the following named officers: President, J. E. Mitchell; vice-president, James E. Merrihew; secretary and superintendent, W. T. Westbrook; treasurer, W. J. McLaughlin.

MINNEAPOLIS, MINN.—The Northwestern Telephone Exchange Company has sued out a writ of temporary injunction to restrain the city from meddling with the poles with the intention of preventing their erection on Lake Street in this city. There is a city ordinance forbidding the erection of poles in the streets, but the company pleads that under the act of Congress it may proceed to put up poles on any street which is a part of a mail route; that the fact that mail carriers operate on Lake Street makes that thoroughfare a mail route, and that a telephone company is essentially a telegraph company within the meaning of the statute referred to.

ELECTRIC LIGHT AND POWER.

ROCK RAPIDS, IA.—M. I. Bigelow has been awarded the contract for the building of the electric light plant at Neola, Ia.

ROCHESTER, N. Y.—Bids will be received by the village of Charlotte up to June 2 for the sale of $35,000 worth of bonds to construct water and electric light works.

HAMILTON, OHIO.—The general manager of the Miami Valley Traction Company has made application to the State Board of Public Works for the use of electric power on the Miami & Erie Canal

LANCASTER, PA.—The Lancaster Electric Light, Heat & Power Company has voted to increase its capital stock from $150,000 to $200,000, and to issue bonds not exceeding $100,000, the money to be used to improve the plant.

SYRACUSE, N. Y.—The Syracuse Electric Light & Power Company will apply to the Common Council for a subway franchise. This company wants a subway franchise of its own, and has refused to place its wires in the Hughes subways.

AURORA, ILL.—A new steam engine and a 2000-light dynamo will be added to the present lighting capacity of the local plant. The power house will also be enlarged, adjoining property for that purpose having just been acquired for $5000.

TRENTON, N. J.—The Trenton Light & Power Company will place its wires underground. The work will be commenced within a month, and will comprehend the laying of 70,000 feet of conduits. The Delaware & Atlantic Telephone Company is now engaged in the work of placing its wires underground.

PHILADELPHIA, PA.—A consolidation is reported to have been made between the Wilmington, Del., City Electric Company and the Wilmington Light, Heat & Power Company, which was about to build an extensive plant. The electric company has purchased the patent rights of the light, heat and power company and its charter franchises. The terms are now made public.

CHICAGO, ILL.—The electric companies operating south of Thirty-ninth Street are not yet in control of the Chicago Edison Company, as was reported. The statement that the Edison Company is consolidating what it does not possess is therefore premature. Negotiations have been pending for some time, but their success depends on the attitude of the Calumet Company.

PROVIDENCE, R. I.—This city has recently made a new contract with the Narragansett Electric Light Company, in which the price of lights is reduced. The old contract was for 35 cents a light a night, 2000 candle power, and the contract expired in 1902. By the new arrangement the company agrees to reduce the price of lights after 1900 to 32½ cents, and three years after to 30 cents. All new lights shall be put in at 30 cents. The contract is extended to 1906, and the company agrees to put all wires in the compact part of the city under ground at a cost of $500,000. The city of Providence has 2000 arc lights.

ELIZABETH, N. J.—The Consumers' Light, Heat & Power Company filed articles of incorporation in the Union County Clerk's office May 20, with a capital of $1,000,000. The incorporators are George F. Chapman, Elizabeth; David Young, John W. Omberson, William and E. O'Connor, Newark; William J. Davis, Harrison, and John R. McArthur, Jersey City. The company will have headquarters in Elizabeth; Essex, Union, Hudson and Middlesex counties will be supplied. The new concern is a union of the Newark and

other nearby electric companies, and represents the interests of the North Jersey Traction Company. Vice-President Garret A. Hobart and Senator James Smith are interested in it. It is expected that the new company will be merged into the Suburban Electric Company of Elizabeth, whose interests in part have recently been transferred, and that the object of the organization is to supply power to the North Jersey Traction Company, principally in Union and Middlesex counties.

TOLEDO, OHIO.—The Toledo Consolidated Electric Company is distributing, with its compliments, an artistically gotten up pamphlet, which is copyrighted by Mr. A. A. Ackinson, entitled "The Evolution of Light." The story is told in poetry of the beginning and development of artificial light, from the days of the ancient oil lamp to the electric arc and incandescent lamps of our time. The first and last stanzas are given herewith:

"When man dwelt in the darksome forests,
Vast and lone,
And the simple, rude log cabin
Was his home;
As he sat by winter firelight's
Flickering rays,
He ne'er dreamed that in the future,
Far away,
Man would learn to turn the midnight
Into day.

"But the climax of the wonders
of the age,
Far surpassing wildest dreams of
Wisest sage,
Fairest rival of the sunshine
In its might,
Or a thousand stars of heaven
Gorgeous bright,
Is the mystic incandescent's
Globe of light."

The Electric Railway.

BUFFALO, N. Y.—The Lock City Electric Street Railway of Lockport will be sold under mortgage foreclosure June 8.

ATTLEBORO, MASS.—The Mansfield & Easton Railroad Company will increase its capital stock from $80,000 to $125,000.

TAUNTON, MASS.—It is understood that the incorporators of the Summer Street Railway to East Taunton will not accept a franchise if the fare is to be limited to 5 cents to East Taunton.

SPRINGFIELD, MASS.—The Mountain Park and Mount Tom lines were opened for the season on May 20. Half-hour trips will be run from the foot of the mountain to the summit. Great improvements have been made.

MILLBURY, MASS.—A franchise has been granted for an electric road from Webster to Worcester through Auburn, a distance of 12 miles. The cost will be about $200,000, and it is said the road may be finished this season.

TROY, N. Y.—Hearings have been had at Waterford as to valuations of properties required by the Mechanicville & Stillwater Electric Railway. From evidence produced it is likely that a settlement favorable to all will be reached.

BUFFALO, N. Y.—The corporation counsel has rendered an opinion to the Aldermanic Committee on Ordinances to the effect that the city has no authority to pass an ordinance providing for 3-cent fares in this city. Alderman Darmstadter's resolution, therefore, will prove futile.

COUNCIL BLUFFS, IA.—The contract for the erection of a new power house for the Omaha & Council Bluffs Railway & Bridge Company has been let to Wickham Brothers. The building will face Second Avenue. Work will commence at once, and the building will be the finest of its kind in the West.

FALL RIVER, MASS.—The new electric railway between this city and Newport will be in operation as soon as the power house is completed and the motive power is obtainable. The cars are expected to arrive within a week. The poles and wires are all in position in Tiverton, and the poles are being painted.

ASBURY PARK, N. J.—The Atlantic Coast Electric Railroad Company is furnishing power from its Asbury Park plant to run the Atlantic Highlands, Red Bank & Long Branch trolley road. The power was furnished by the Red Bank Electric Light Company, but owing to some disagreement a change was made.

NEW YORK CITY.—Rumors have been revived that negotiations have been renewed for the lease of the Brooklyn Elevated Railroad by the Brooklyn Rapid Transit Company, and that when the deal is perfected the elevated structure will be largely used for fast through service and the surface lines be given up to local service.

NEW HAVEN, CONN.—The Westport and Southport trolley extension of the Bridgeport Traction Company has been opened, the fare between Bridgeport and Norwalk being fixed at 20 cents. The Western or Washington Bridge section of the Milford Street Railway Company was opened on Decoration Day, and the whole system of 10 miles, including the Woodmont line, will be in operation on July 1.

SYCAMORE, ILL.—A fifty-year franchise has been granted to the Geneva Lake, Sycamore & Southern Electric Railway Company. The line runs from Geneva Lake, Wis., to Morris, Ill. The road is to carry passengers, mail, express and freight, and its general offices will be located here. The length of the road will be 110 miles, and it will cross ten other railroads, nine of which lead to Chicago and one to Milwaukee. The company was incorporated on January 13 this year. Work will start at once.

BUFFALO, N. Y.—The Niagara Falls & Clifton Bridge Company has granted the exclusive right to the Niagara Falls Park & River Railway Company to operate cars across the new steel arch bridge that is now being erected to take the place of the upper suspension bridge. The terms of the deal are private. The Canadian company will establish itself on the American side of the river, and will erect a station on the property of the bridge company. The competition for the privilege of operating cars on the bridge was very keen, for the franchise is a valuable one. The bridge will be completed by June 1, and the tracks of the trolley company will at once be laid.

JERSEY CITY, N. J.—Edward F. C. Young, president of the Consolidated Traction Company, and Second Vice-President David Young, resigned their offices at a meeting of the directors held in this city last week. Mr. B. M. Shanley was elected president. It is not likely that the office of second vice-president will be filled, as the lease of the company's plant and franchise to the North Jersey Street Railroad Company, for ninety-nine years, has gone into effect. The latter company now controls all the trolley system in Northern New Jersey, with the exception of the North Hudson County Railway Company. It is understood that Mr. E. F. C. Young was elected president of the North Jersey Street Railroad Company, which was reorganized last week, and that Mr. David Young was elected second vice-president and general manager to succeed Mr. H. N. Doremus.

NEW HAVEN, CONN.—An ambitious trolley enterprise is afoot looking ultimately to a continuous trolley line 60 miles long, between Norwich and Worcester, and paralleling the Norwich and Worcester steam road. It involves the co-operation of five companies, three in Connecticut and two in Massachusetts. One of the companies is about to build a link of the proposed line from Putnam, Conn., to East Thompson, Conn., under an existing charter, and the plans have been drawn for the rest of the line in Connecticut and petitions filed in Massachusetts. While the various parts of the plan must, with but one exception, have legislative authority in Connecticut, and must also, as parallels, be passed upon by the State courts, the region is a somewhat favorable one for trolley enterprise, and is very likely ere long to be new fighting ground of steam and trolley interests.

Legal Notes.

A VERDICT for the plaintiff was given last week in the Supreme Court, New York, in the case of William Bracken against the Atlantic Trust Company. We are informed by the plaintiff that this was a suit to recover damages for the retention by the Atlantic Trust Company of 30,000 shares of the capital stock of the Consolidated Electric Storage Company, to the delivery of which Mr. Bracken claims he was entitled. The amount of the verdict is $151,124.82.

THE ELECTRIC CAR COMPANY OF AMERICA AND THE THOMSON-HOUSTON ELECTRIC COMPANY V. THE HARTFORD AND WEST HARTFORD RAILROAD COMPANY, ET AL.—The opinion in the suit on the infringement of patent No. 393,323, issued to G. H. Condict, for a combination of rheostatic and series multiple control of car motors, has been handed down by Judge Townsend of the United States Circuit Court, District of Connecticut. The opinion cites Claims 15 and 16 as non-infringing, and enters a decree for an injunction and an accounting as to Claims 20, 21, 22, 27, 28, 29 and 31. The attorneys in the case were Messrs. Betts, Betts, Sheffield & Betts, for the plaintiffs, and for the defendants Messrs. Charles E. Mitchell and William F. Henney.

THE ANCHOR ELECTRIC COMPANY, of Boston, has secured a decree by the full bench of the Supreme Court of Massachusetts restraining Mr. H. G. Hawks from interfering or competing with its business for a period of five years from September 29, 1894. The agreement on which the injunction was based was made at the time of the consolidation of the Iona Manufacturing Company, the Hawks Electric Company and the Brown Electric Company, which resulted in the formation of the Anchor Electric Company. All the officers of the old companies signed the agreement not to compete, and the court holds that the agreement went no further than was reasonably necessary to protect the good will of the Anchor Electric Company, and is enforcible against Mr. Hawks. This is the same decision that was rendered some time ago by Judge Holmes. It is now affirmed by the full bench of the Supreme Court.

THE SUPREME COURT of the United States on May 23 rendered a decision in the Detroit street railway franchise controversy. According to a dispatch from Washington this decision was adverse to the Detroit Citizens Street Railway Company. The latter is the successor to the Detroit City Railway, which, by an ordinance passed by the Detroit Council in 1862, was exclusively authorized to construct and operate street railways in the city. By an ordinance of 1879 this right was extended thirty years. In 1894 an ordinance was passed granting to the Detroit Railway the right to construct railways upon some of the streets occupied by the Citizens Company. The latter brought suit against the Detroit Company and the city of Detroit to prevent them from carrying out the terms of the ordinance of 1894, asserting that it violated a contract made with the Citizens Company. The State courts held that the Council had no power to grant exclusive right to the Citizens Company, and their judgment was affirmed by the Supreme Court.

THE SPRAGUE ELECTRIC RAILWAY & MOTOR COMPANY V. THE UNION RAILWAY COMPANY AND THE WALKER COMPANY.—The United States Circuit Court of Appeals has rendered a decision in this case for infringement of the Sprague patent No. 324,892, covering a method of railway motor suspension. The claims found by the Circuit Court to have been infringed are as follows:

"2. The combination of a wheeled vehicle and an electro-dynamic motor mounted upon and propelling the same, the field magnet of said motor being sleeved upon an axle of the vehicle at one end, and supported by flexible connections from the body of the vehicle at the other end, substantially as set forth."

"6. The combination, with a wheeled vehicle, supported upon its axles by springs of an electro-dynamic motor flexibly supported from such vehicle, and centered upon the driving axle thereof, substantially as set forth."

"9. The combination, with a wheeled vehicle, of an electro-dynamic motor centred upon the driving axle thereof at one end, a spring support for that end of the motor from the truck or body of vehicle, and relieving axle wholly

or partly of dead weight, and a spring support for the other end of motor from the truck or body of vehicle, substantially as set forth."

The court holds that Claims 2 and 6 are infringed and orders an accounting on these claims. Claim 9 is held not to be infringed.

PERSONAL NOTE.

MR. W. D. WEAVER has received his commission as passed assistant engineer in the United States Navy, with the rank of Lieutenant, and soon expects to be assigned to active service.

OBITUARY NOTES.

MR CHARLES J. GOODWIN, treasurer and manager of the Chapman Valve Manufacturing Company, Indian Orchard, Mass., died at his home in that place, May 27, of malarial fever. Mr. Goodwin had been connected with the company for many years and was held in high esteem.

MR. HENRY OSTERBERG, father of Mr. Max Osterberg, died at his home in New York City, on May 23. Mr. Osterberg was a native of Germany, and came to this country when sixteen years of age. During 1865-68 he was prominently identified with financial institutions in Germany and other European countries. Mr. Max Osterberg is one of the two surviving children of the deceased, and his many friends in the electrical field sympathize with him in the loss of his parent.

TRADE PUBLICATIONS.

THE PECK, STOW & WILCOX COMPANY, 27 Murray Street, New York, has issued an illustrated price list of safety gas and burner pliers, also side cutting pliers. The handles of the safety pliers are covered with patent insulation which, it is stated, is tested to 2500 volts.

"MACHINERY AND SUPPLIES FOR MINES AND MILLS" is the title of a publication issued monthly by Charles E. Billin & Co., engineers, purchasing and forwarding agents, Chicago, Ill. It is the endeavor of the publishers to give concise information of the character which the manager or engineer desires when deciding what machinery or supplies may be best to purchase.

Trade and Industrial Notes.

WRITE to the Charles Munson Belting Company, 36 South Canal Street, Chicago, for one of its celluloid penholders.

THE DAYTON GLOBE IRON WORKS COMPANY, Dayton, Ohio, has bought out and now controls the Dayton gas engine.

THE CHAMBERSBURG ENGINEERING COMPANY, Chambersburg, Pa., announces that it has designed and is giving special attention to direct connected single and tandem compound engines, with extended sub-base under the cylinder.

THE GEO. M. MAYER MODEL AND MACHINE WORKS, 79 Fifth Avenue, Chicago, are busy filling orders for Mayer drops, spring jacks, plugs and other switchboard supplies. They report a favorable outlook for the coming summer season.

THE AMERICAN ELECTRICAL WORKS, Providence, R. I., is sending out a souvenir of Memorial Day in the shape of a fine steel-plate portrait of Abraham Lincoln. The American Electrical Works appropriately commemorates the principal national holidays, and is original in its expressions of patriotism.

EVEN SPAIN shares in the general rush for American electrical machinery. The Westinghouse Electric & Manufacturing Company, through its London representatives, has installed one of its 135-kw single-phase separately excited alternators, belted to a Westinghouse engine, for the Malaga Electricity Company, of Malaga, Spain.

THE CENTRAL ELECTRIC COMPANY, Chicago, announces that it has taken the agency for the products of the Varley Duplex Magnet Company, of New York, manufacturer of magnets of every description, and will carry in stock all styles of standard cells for telephone construction. Special designs will be furnished on application.

MR. JOSEPH M. ZAMOISKI, formerly of the Zamoiski-Palmer Company, Baltimore, Md., and Mr. E. W. Phillips, general manager, secretary and treasurer of the Maryland Manufacturing & Construction Company, Baltimore, have formed a partnership under the name of J. M. Zamoiski & Co., as manufacturers' agents, with offices at room 515 Equitable Building, Baltimore. The new firm will represent only manufacturers of electrical supplies, dynamos and motors, engines and boilers.

THE ILLINOIS ELECTRIC COMPANY, Chicago, has found it necessary to lease the entire basement at 239 Madison Street, in order to obtain greater facilities for the handling of its increasing business. The space is 50x150 feet, and there is a large freight elevator at the rear. The company purposes to carry a large line of cross arms, cross-arm braces, pins and brackets, lag screws, pole steps, etc. This stock will enable the company to fill orders on the day they are received.

PIONEER LAMPS ORDER.—Kaufman Brothers, Pittsburg, have placed an order with the Electric Arc Light Company, New York, for over 400 Pioneer enclosed arcs for their building. A unique feature of this installation will be the complete lighting of the store with arcs, and combination arc and gas chandeliers. This is said to be the first store in the country to be entirely equipped in this manner. It is stated that the Pioneer lamp was selected after a three months' competitive test against other makes of enclosed lamps on the market.

IN ADDITION to its usually complete line of fan motors operative upon electric light circuits, the Central Electric Company, of Chicago, in order to meet the gradually increasing demand, has placed in stock a very complete line of fan motors operative from storage and primary battery circuits; prominence being given to the Edison-Lalande battery fan outfits. There is many a place and many a time when these "atmosphere accelerators" prove to be very serviceable. In a sick room they serve to keep a gentle circulation of the air that is exceedingly refreshing to a patient. Special circulars will be sent on application.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has recently closed a general Western agency arrangement for Armorduct interior conduit. The Armorduct is the latest product of the Armorite Interior Conduit Company, manufacturer of Armorite steel armored interior conduit. The Armorduct is a steel tube heavily enameled inside and outside by a special and exclusive process. The enamel placed on this tube gives a perfectly smooth interior, with a coating which will withstand a temperature of 500 degrees. Bending and twisting the tube will not crack or break the coat of enamel. Futher than this the enamel is absolutely proof against the action of cements or acids of any description.

AMONG the prominent manufacturing firms that have recently adopted electricity for shop power is the Atlas Tack Company, Taunton, Mass. A 150-kw 440 volt, 3000 alternation Westinghouse three-phase generator has been installed, together with nine of the Westinghouse type "C" motors, for the operation of three large tack mills, extending for a radius of 1500 feet about the power plant. The installation of this apparatus will enable the purchasers to shut down two steam plants, to cut out a great deal of long shafting, and to greatly increase the efficiency of the entire plant. Some twenty or thirty additional Westinghouse motors are to be installed in a short time, together with a 1000 light Westinghouse dynamo.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, is mailing to all telephone companies an advance sheet giving specifications and illustrations of new systems and apparatus which it is getting out and thoroughly testing in actual exchange operation before placing on the market. This advance sheet is sent out on account of the delay in the regular issue of the company's catalogue. Incidentally, we may note that it embodies a new idea in the circular line. It has a regular paper cover, which encloses a large sheet, neatly folded. The cover is so designed as to provide space for an address and stamp, and it is mailed without any envelope, the right-hand end being sealed, to be torn open along a line of perforations. The idea is that of Mr. Henry Shafer, of the company.

THE WESTINGHOUSE induction motor—known as the type "C" machine—has recently extended its usefulness to a unique field in North Carolina, namely, in operating fertilizing machinery. The Westinghouse Company has recently supplied the Fries Manufacturing Company, of Salem, N. C., with six of these motors and a number of lighting arresters, high tension transformers, etc., which are to be used for the above purpose, and also for driving a city pumping station, planing mill, machine shop, iron foundry, etc. The choice of Westinghouse motors was made largely on account of their extreme simplicity. They will be operated by workmen entirely unfamiliar with electrical machinery. This is one of the first installations of the character in North Carolina, and is being watched with great interest throughout the State.

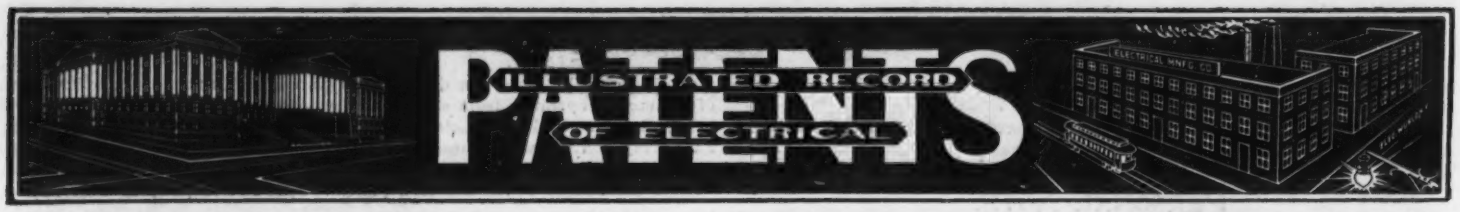
THE ONONDAGA DYNAMO COMPANY, Syracuse, N. Y., through its New York agents, Fairchild & Sumner, reports the following recent sales: One hundred and ninety horse-power in motors to the Atlas Cement Company, Northampton, Pa.; National Hat Company, Newark, N. J., 30-kw generator for lighting and heating. In the future the National Hat Company will do its flat-iron work by electricity; 5-hp motor, American News Company, Newark, N. J.; 10-hp motor to William T. Jancobius, Electric Carpet Cleaning Works, Newark, N. J.; 10-hp slow speed reversible elevator motor for the Causse Manufacturing Company, Jersey City, N. J.; 15-hp slow speed ceiling motor, the American Soda Fountain Company, Boston, Mass.; one 250-light lighting plant to Pass & Co., Wallabout Street, Brooklyn, N. Y.; two 10-kw gas engine generators, with complete installation for the Brown & Van Anglen Company, Newark, N. J.; 60-kw generator to the Paterson Silk Mills, Paterson, N. J. It also reports the second installation of the special 60-volt exciter generator, direct connected, for the New York & Staten Island Electric Company, Livingston, S. I.

A NEW TELEPHONE MANUFACTURING COMPANY.—The Maryland Telephone Manufacturing Company has been organized at Baltimore, Md., and has established a factory at Nos. 11 and 13 East Lee Street in that city, under the general superintendence of Mr. C. B. Clark, formerly electrician of the Home Telephone Company, of Mobile, Ala. The officers of the new company are: M. Meyerdirck, president; H. H. Hobelman, vice-president; H. Knollenberg, secretary. The sales office of this company has been located at 130 Fulton Street, New York City, and placed in charge of Mr. Paul Minnis, an electrical engineer and telephone inventor. A complete line of up-to-date samples of the various types of telephones manufactured by the Maryland Company will be found at the New York office. This company is making features of the Brown loud speaking transmitter and the Minnis system of telephones and switchboards, the latter being covered and protected by nearly a score of patents. The company is now in the market for all kinds of exchange orders, as well as orders for interior and intercommunicating sets, extension bells, desks, etc.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

THE AMERICAN NAVY, CUBA AND HAWAII.—A portfolio, in ten parts, sixteen views in each part, of the finest half-tone pictures of the American Navy, Cuba and Hawaii has just been published, and the Chicago, Milwaukee & St. Paul Railway has made arrangements for a special edition for the benefit of its patrons, and will furnish the full set, 160 pictures, for $1. In view of the present excitement regarding Cuba these pictures are very timely. Send amount with full adddress to George H. Heafford, General Passenger Agent, C. M. & St. P. Ry., Chicago, Ill.



UNITED STATES PATENTS ISSUED MAY 24, 1898.

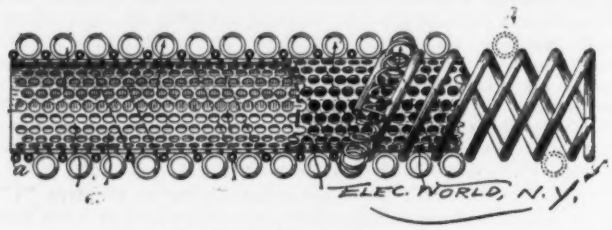
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

604,358. VALVE-CONTROLLING DEVICE; W. S. Alexander, New York, N. Y. App. filed Feb. 24, 1896. This invention relates to improvements in valve controlling devices, and particularly to that class of valve controllers wherein a valve of comparatively large capacity is controlled through the operation of a valve of comparatively small capacity.

604,373. AUTOMATIC TELEPHONE EXCHANGE; W. Decker, Owego, N. Y. App. filed March 25, 1895. In a system of electrical intercommunication a short circuited telephone receiver, a circuit breaker for breaking the short circuit, an electromagnet for operating the circuit breaker, all in combination with a calling generator connected with said electromagnet, whereby the short circuit is broken on operating the calling generator.

604,384. ELECTRIC HEATER; E. E. Gold, New York, N. Y. App. filed Oct. 14, 1897. An electric heater, comprising an insulating open work support, consisting of a thin foraminous tube and a helix of resistant wire wound helically around said support, whereby air may circulate between the meshes of said helix and through the openings into and out of the interior of said support and into contact with all portions of the heated resistance wire.

604,418. ACCUMULATOR PLATE; I. Rosler, Berlin, Germany. App. filed March 10, 1898. An accumulator plate, consisting of a continuous zig-zag



604,384.—ELECTRIC HEATER.

core piece, the surfaces of which on both sides are fitted with triangular webs wholly separated from each other.

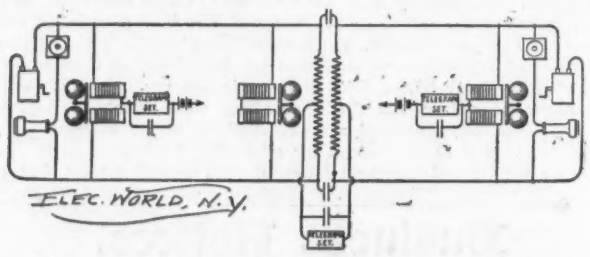
604,431. ELECTRIC SIGNAL FOR RAILWAY CROSSINGS; L. C. Smith, Columbus, Ohio. App. filed May 18, 1897. This invention relates to improvements in electric signaling devices for railways, and has particular relation to that class of signaling devices by means of which danger signaling bells are automatically rung where roadways or streets cross railway tracks.

604,434. TELEPHONE SIGNAL SYSTEM; W. A. Stilwell and A. Barneck, Salina, Kan. App. filed Nov. 10, 1896. This invention relates to improvements in telephone signal systems in which a series of subscribers or substations are connected with a central station, and the object is to provide a simple and reliable means whereby any one subscriber can connect his telephone with any other subscriber at will.

604,453. SECONDARY ELECTRIC CLOCK; A. D. Blodgett, Newton, Mass. App. filed May 29, 1897. This invention relates to improvements in time dial movements, whereby the operation of the same is made more positive and certain and the construction simplified.

604,459 to 466, inclusive. ELECTRIC METERS; T. Duncan, Fort Wayne, Ind. Apps. filed respectively March 20, Aug. 6, Aug. 6, Aug. 11, Aug. 26, Sept. 11, 24, Nov. 8, 1897. These inventions relate to improvements in alternating current meters, electric motor meters, integrating ampere hour or coulomb induction meters, integrating wattmeters.

604,471. ELECTRIC BRUSH; Emma M. Hellwig, Chicago, Ill. App. filed Dec. 11, 1896. This invention relates to improvements in that class of brushes used for therapeutical purposes in which a current of electricity is produced by chemical action or by means of a galvanic or voltaic battery.



604,499.—MULTIPLE TELEPHONE AND TELEGRAPHY.

604,499. MULTIPLE TELEPHONY AND TELEGRAPHY; R. Pfund, New York, N. Y. App. filed Oct. 22, 1897. This invention relates to multiple telephony and telegraphy, and has special reference to systems wherein telegraphic or telephonic communication may be carried on between stations, either terminal or intermediate, simultaneously or at will without interference.

604,501. MOTOR WATTMETER; C. D. Raab, Kaiserslautern, Germany. App. filed Dec. 27, 1897. A motor wattmeter having a disc armature, two horseshoe electromagnets placed near each other at one side of the disc armature and a main current solenoid at the other side thereof.

604,508. ELECTRIC CLOCK; W. Whitehead, Manchester, England. App. filed June 7, 1897. In an electric clock, the combination of an armature arm under the influence of a spring with a switch, consisting of a lever having at its upper end a contact adapted to make and break contact with an insulated contact piece, and its lower end being alternately engaged and released by a pawl.

604,511. DRIVING MECHANISM FOR DYNAMOS; P. W. Alexander, Allapaha, Ga. App. filed Sept. 21, 1897. This invention is in the nature of an attachment to railroad cars, whereby the rotation of the axle of the car is utilized for the running of a dynamo located within the car.

604,533. COMBINED TRANSMITTER AND RECEIVER; J. M. Joy, New York, N. Y. App. filed June 21, 1897. In a printing telegraph apparatus, a type wheel carried rotatively by a shaft, a carriage to move the type wheel longitudinally on the shaft, a transmitter having a circuit controlling shaft, a motor connected to operate the type wheel, the carriage and the circuit controlling shaft, and arranged to exert a constant stress upon the same, and escapements controlling the operation of the type wheel, carriage and transmitter shaft.

604,588. STORAGE BATTERY; H. S. Lloyd, Philadelphia, Pa. App. filed Dec. 23, 1896. A battery cell, comprising a vessel having vertically disposed passages formed by partitions arranged at the sides of the vessel for the escape of any excess of electrolyte and for the passage of the connecting wires or strips.

604,616. AUTOMATIC RESETTING FUSIBLE CUT-OUT; J. D. Holmes and W. L. Heath, St. Louis, Mo. App. filed April 12, 1897. In a fusible cut-out, a movable member, fuse holding devices carried by said movable member, and normally locking the same, said fuse holding devices being arranged in pairs and insulated from each other, means for releasing said movable member when a fuse is burned out, and line wire terminals adapted to be put in electrical communication with one pair only of said fuse holding devices at a time.

604,626. ELECTRICAL LIGHTING DEVICE FOR KEROSENE OR OTHER BURNERS; S. M. Meyer, Brooklyn, N. Y. App. filed Jan. 27, 1897. In combination with a lamp burner and a suitable source of electricity and conductors; a contact arm and a contact spring, vibrating in an arc approximately tangential to the wick of the lamp burner.

604,679 to 688. D. McF. Moore, Newark, N. J., as follows:

INCANDESCENT ELECTRIC LAMP REGULATOR. Filed Feb. 10, 1892. This invention relates to means for turning up and down the light of an incandescent electric lamp.

ELECTRIC LAMP REGULATOR. Filed Oct. 13, 1894. This invention relates to improvements on previous ones.

INTERRUPTER FOR ELECTRIC LIGHTING SYSTEMS. App. filed Dec. 3, 1895. This invention relates to magnetically actuated circuit interrupters operated in a vacuum and in a circuit of induction for the purpose of generating electric waves, disturbances or discharges suitable for producing luminous or other effects.

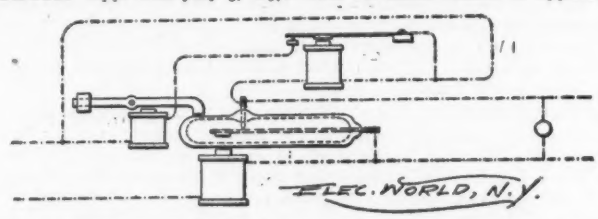
MAGNETIC CIRCUIT BREAKER. App. filed Sept. 8, 1896. This invention relates to magnetically actuated circuit breakers, and is especially designed for use in electric lighting systems heretofore patented by the inventor.

MAGNETIC CIRCUIT BREAKER. Filed Sept. 8, 1896. Similar to one next above described.

AUTOMATIC VIBRATORY INTERRUPTER. Filed Dec. 17, 1896. This invention relates to automatic circuit interrupters of the vibratory type, and is designed more particularly to improve upon interrupters of the class wherein the action is produced by an electromagnet, the circuit of which is broken at each vibration.

ELECTRIC LIGHTING APPARATUS. App. filed Feb. 15, 1897. This invention relates to apparatus designed to generate electric vibrations or disturbances by rapidly repeated interruptions of a circuit supplied with currents from any suitable source, and is more particularly designed for use in the system heretofore patented by the inventor.

APPARATUS FOR PRODUCING LUMINOUS OR SIMILAR EFFECTS. App. filed July 3, 1897. This invention relates to apparatus for



604,684.—AUTOMATIC VIBRATORY INTERRUPTER.

producing luminous or similar effects, such as Röntgen rays, from exhausted receivers, or other devices operated by the electric vibrations or disturbances generated through rapidly repeated interruptions of a circuit of induction.

CIRCUIT INTERRUPTING MECHANISM. App. filed Sept. 9, 1897. This invention relates to magnetically operated circuit interrupters, and particularly to such interrupters adapted for use in vacuum chambers or receptacles.

CIRCUIT INTERRUPTER. App. filed Sept. 10, 1897. Similar to one next above described.